JUACEP Summer Program 2012 at Nagoya University

~July 1st - August 30th~

Japan-US Advanced Collaborative Education Program

Nagoya University

Published in November, 2012

Leaders of JUACEP
Prof. Noritsugu Umehara
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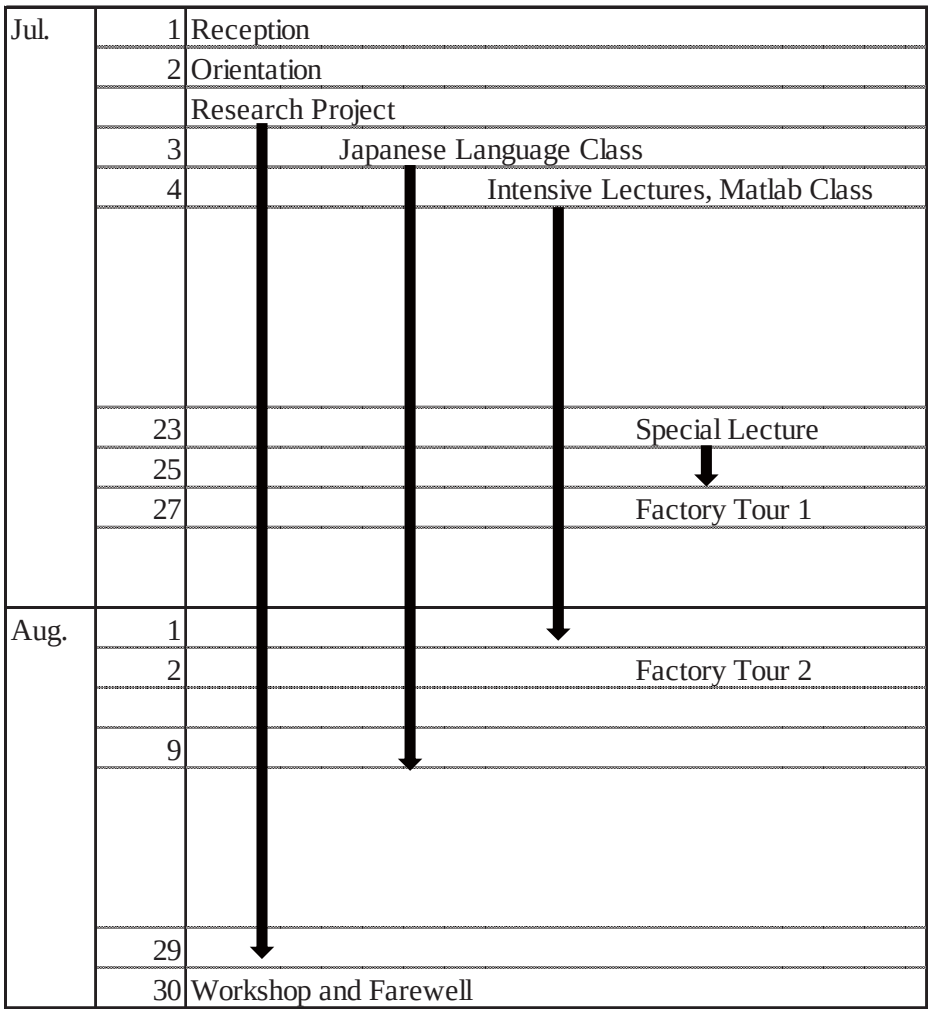
About the Program

1-a. Overview

This program was designed for senior-level undergraduate and graduate students of University of Michigan. The theme of 2012 was ‘the Disaster Reconstruction and Energy Storage’. Each student had internship at laboratory of Nagoya University and worked on the specific research project under the direction of NU advisor. They gave the final presentation at the workshop about their project findings through the internship. Also, Japanese language class, intensive lectures, special lecture and factory tours were offered.

~Program Contents~

Duration: July 1 – August 30, 2012



1-b. Participants

Students from University of Michigan

Sajeev Gulyani	Aerospace Engineering (M2)	sajeevg@umich.edu
Lu-Yin Wang	Aerospace Engineering (M2)	luyin@umich.edu
Sean Triputra Bong	Mechanical Engineering (M1)	stbong@umich.edu
Yu Ning	Mechanical Engineering (M1)	ningyu@umich.edu
Mudit Rastogi	Mechanical Engineering (M1)	mudit@umich.edu
Pattarawit Sae-Ong	Energy Systems Engineering (M1)	ptrw@umich.edu
Nanda Gopalan Venkata Ramanan	Mechanical Engineering (M1)	nvenkata@umich.edu
Syed Talha Wasif	Mechanical Engineering (M1)	wasif@umich.edu
Qiongyu Lou	Mechanical Engineering (B4)	louq@umich.edu

Advisors at Nagoya University

Prof. Masashi Hasegawa	Crystalline Materials Science	hasegawa@numse.nagoya-u.ac.jp
Prof. Tetsuo Iguchi	Quantum Engineering	t-iguchi@nucl.nagoya-u.ac.jp
Prof. Yang Ju	Mechanical Science and Engineering	ju@mech.nagoya-u.ac.jp
Prof. Kunihito Koumoto	Applied Chemistry, Chemical Engineering and Biotechnology	koumoto@apchem.nagoya-u.ac.jp
Prof. Noritsugu Umehara	Mechanical Science and Engineering	ume@mech.nagoya-u.ac.jp
Prof. Akio Yamamoto	Materials, Physics and Energy Engineering	a-yamamoto@nucl.nagoya-u.ac.jp
Assoc. Prof. Takeyoshi Kato	Electrical Engineering and Computer Science	tkato@nuee.nagoya-u.ac.jp
Assoc. Prof. Kouji Nagata	Mechanical Science and Engineering	nagata@mech.nagoya-u.ac.jp
Res. Lecturer Yasumasa Ito	Mechanical Science and Engineering	yito@nagoya-u.jp

Visiting Lecturers

Mr. Asao Uenodai	Honda Motor Co., Ltd
Dr. Yo Kobayashi	Central Research Institute of Electric Power Industry
Dr. Takao Watanabe	Central Research Institute of Electric Power Industry
Prof. Tomoaki Kunugi	Department of Nuclear Engineering, Kyoto University
Mr. Masaki Azuma	Toyota Motor Corporation
Mr. Kiyoshiba Mase	Toyota Motor Corporation
Mr. Manabu Ozawa	Toyota Motor Corporation
Ms. Sumie Yasui	Japanese Teacher
Ms. Haruna Kishi	Japanese Teacher

Coordinator

Prof. Katsuo Kurabayashi (University of Michigan)	Mechanical Engineering	katsuo@umich.edu

Steering Committee of JUACEP

Prof. Toshio Fukuda	Micro-Nano Systems Engineering	fukuda@mein.nagoya-u.ac.jp
Prof. Goro Obinata	Mechanical Science and Engineering	obinata@esi.nagoya-u.ac.jp
Prof. Eiji Shamoto	Mechanical Science and Engineering	shamoto@mech.nagoya-u.ac.jp
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Assoc. Prof. Yoko Yamanishi	Micro-Nano Systems Engineering	yoko@mech.nagoya-u.ac.jp
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Prof. Yang Ju	Mechanical Science and Engineering	ju@mech.nagoya-u.ac.jp
Res. Lecturer Yasumasa Ito	Mechanical Science and Engineering	yito@nagoya-u.jp
Designated Asst. Prof. Satoru Tokuda	Mechanical Science and Engineering	tokuda@esi.nagoya-u.ac.jp
Tomoko Kato	Administrative Officer	tomoko@mech.nagoya-u.ac.jp
Chiharu Yada	Administrative Officer	yada@mech.nagoya-u.ac.jp

1-c. Schedule

JUACEP Summer Program 2012 Schedule

Day	Date		8:45-10:15	10:30-12:00		13:00-14:30	14:45-16:00	16:15-
1	**6/29/2012**	Fri	Arrival at Nagoya					
2	**6/30/2012**	Sat						
3	**7/1/2012**	Sun						16:00-17:00 Mini reception @Residence Higashiyama 1F
4	**7/2/2012**	Mon	Orientation (10:00- @ES032)		Lunch @ Chez Jiroud	1.Stipend, tuition(13:00-13:30 @ Account Office) 2. Insurance, admission fee, in-bound ticket. Passport, out-bound ticket photocopy (13:30-14:00 @ Eng2-320) 3. Introduction to lab TAs & assignation to each laboratory (14:00- Eng2-320)		Research at Lab
5	**7/3/2012**	Tue	Japanese Lang A (Eng2-221) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
6	**7/4/2012**	Wed	Matlab Class (Eng3-441)			"Energy storage and battery overview" (Lecturer Ito, Nagoya U, Eng2-241)	Research at Lab	Research at Lab
7	**7/5/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-320)			"Fuel cell vehicle research at Honda I" (Mr. Uenodai, Honda R&D, Eng2-231)	"Fuel cell vehicle research at Honda II" (Mr. Uenodai, 15:00-16:30, Eng2-231)	Research at Lab
8	**7/6/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
9	**7/7/2012**	Sat						
10	**7/8/2012**	Sun						
11	**7/9/2012**	Mon	Research at Lab	Research at Lab		"Batteries for stationary applications" (Dr. Kobayashi, CRIEPI, Eng1-132)	Research at Lab	Research at Lab
12	**7/10/2012**	Tue	Japanese Lang A (Eng2-221) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
13	**7/11/2012**	Wed	Research at Lab	Research at Lab		"Fuel cell" (Dr. Watanabe, CRIEPI, Eng2-241)	Research at Lab	Research at Lab
14	**7/12/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)			"Zinc-anode batteries" (Lecturer Ito, Eng2-231)	Research at Lab	Research at Lab
15	**7/13/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
16	**7/14/2012**	Sat						
17	**7/15/2012**	Sun						
18	**7/16/2012**	Mon	Marine Day (holiday)					
19	**7/17/2012**	Tue	Japanese Lang A (Eng2-424) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
20	**7/18/2012**	Wed	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
21	**7/19/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
22	**7/20/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
23	**7/21/2012**	Sat						
24	**7/22/2012**	Sun						
25	**7/23/2012**	Mon	Research at Lab	Lecture1 by Prof. Kurabayashi (ES032)		Problem Session (13:30-15:00, ES032)	Research at Lab	Research at Lab
26	**7/24/2012**	Tue	Research at Lab	Lecture 2 by Prof. Kurabayashi (ES032)		Problem Session (13:30-15:00, ES032)	Research at Lab	Research at Lab
27	**7/25/2012**	Wed	Research at Lab	Lecture 3 by Prof. Kurabayashi (ES032)		"Reactor thermal hydraulics and safety" (Prof. Kunugi, Kyoto U, Eng2-231)	Project Presentation (15:00-17:00, ES032)	Research at Lab

28	**7/26/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)			"Development of future green vehicles" (Mr. Azuma, Toyota, Eng2-231)	Research at Lab	Research at Lab
29	**7/27/2012**	Fri	Toyota Motor Factory Visit (10:30-13:00) Departure: 9:30, Arrival: 14:00				Research at Lab	Research at Lab
30	**7/28/2012**	Sat						
31	**7/29/2012**	Sun						
32	**7/30/2012**	Mon	Research at Lab	Research at Lab		"Future materials for automobiles" (Mr. Ukai, Toyota, Eng1-132)	Research at Lab	Reaearch at Lab
33	**7/31/2012**	Tue	Japanese Lang Field Trip (Nagoya Disaster Prevention Center				Research at Lab	Research at Lab
34	**8/1/2012**	Wed	Research at Lab	Research at Lab		"CFRP body development for Lexus LFA" (Mr. Ozawa, Toyota, Eng2-232)	Research at Lab	Research at Lab
35	**8/2/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)	Research at Lab	Mitsubishi Motors Factory Visit (tentative)			Research at Lab
36	**8/3/2012**	Fri	Excursion～Kyoto Trip～					
37	**8/4/2012**	Sat						
38	**8/5/2012**	Sun						
39	**8/6/2012**	Mon	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
40	**8/7/2012**	Tue	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
41	**8/8/2012**	Wed	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
42	**8/9/2012**	Thu	Japanese Lang A (Eng2-346) Japanese Lang B (Eng2-347)			Research at Lab	Research at Lab	Research at Lab
43	**8/10/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
44	**8/11/2012**	Sat						
45	**8/12/2012**	Sun						
46	**8/13/2012**	Mon	The Bon Festival (holiday)					
47	**8/14/2012**	Tue	The Bon Festival (holiday)					
48	**8/15/2012**	Wed	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
49	**8/16/2012**	Thu	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
50	**8/17/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
51	**8/18/2012**	Sat						
52	**8/19/2012**	Sun						
53	**8/20/2012**	Mon	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
54	**8/21/2012**	Tue	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
55	**8/22/2012**	Wed	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
56	**8/23/2012**	Thu	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
57	**8/24/2012**	Fri	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
58	**8/25/2012**	Sat						
59	**8/26/2012**	Sun						
60	**8/27/2012**	Mon	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
61	**8/28/2012**	Tue	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Research at Lab
62	**8/29/2012**	Wed	Research at Lab	Research at Lab		Research at Lab	Research at Lab	Reaearch at Lab
63	**8/30/2012**	Thu	Mini Workshop (ES103)				Farewell Party (TBD)	
64	**8/31/2012**	Fri	Leaving Nagoya					

Japanese Language Class

Intensive Lectures

Special Lectures

Factory Visits

Research at Each Lab

<2>

Classes & Events

2-a. Japanese Class

JUACEP Summer Program 2012　　Japanese Course Syllabus

Course name	Japanese Language
Teaching staff	Ms. YASUI Sumie, Ms. KISHI Haruna
Course period	July 2 – August 9, 2012
Weekly timetable	Tuesday & Thursday,1st & 2nd period　(8：45-12：00) *August 2 (Thu) 1st period only (8:45-10:15)
Classroom	Room 224, 320, 346, 347
Textbook	"GENKI　An Integrated Course in Elementary Japanese" I (The Japan Times) This textbook is a comprehensive approach to developing the four basic language skills (listening, speaking, reading and writing) in order to cultivate overall Japanese-language ability. Some teaching materials will be given in class.
Course Contents	**Course outline** The purpose of this course is to introduce the most essential Japanese words and expressions for everyday life. Students will learn the basic grammar, expressions and writing system (Hiragana & Katakana) of Japanese. **Classroom activities** Basic communication skills required in everyday life will be taught by introducing new vocabulary, new grammar & structures and practicing listening, conversation and role-playings. Reading and writing of Hiragana and Katakana will also be practiced. **Homework and Quiz** You are expected to submit your homework by the deadline. Quizzes will be given every day in class. 1. Hiragana　2. Katakana 3. Dictation　4. Conjugation
Evaluation	1. Homework　10% 2. Quizzes　20% 3. Written exam.　35% 4. Oral exam.　35% 100%

Course schedule	7/3(Tue) Greeting Expressions, Hiragana Lesson 1 : New Friends Noun sentences 1, Time, Age 7/5(Thu) Hiragana Lesson 2: Shopping Noun sentences 2, Price, Classroom expressions 7/10(Tue) Katakana Lesson 3: Making a Date Verbal sentences, Time reference, Adverbs 7/12(Thu) Katakana Lesson 4: The First Date Describing where things are, Locations, Days/Weeks/Months/Years 7/17(Tue) Lesson 5: A Trip to Okinawa Adjectives, Degree expressions, Counting 7/19(Thu) Lesson 6: A Day in Robert's Life Making a request (Verb-Te-form 1), Describing two things, Directions 7/26(Thu) Lesson 7 : Family Picture Te-form 2, Body parts, Family terms 7/31(Tue) Field Trip: Nagoya Disaster Prevention Center 8/2(Thu) Lesson 8 : Barbecue Plain form 1、Negative request 8/7(Tue) Lesson 8 & 9: Plain form 2 **The Final Examination 1 (writing)** 8/9(Thu) **The Final Examination 2 (speaking),** Exam Feedback

2-b. Special Lecture

JUACEP Summer Internship Lecture Series
"Designing Research Projects and Methods"
Summer2012

Updated 06/21/12

Instructor: Prof. Katsuo Kurabayashi
Department of Mechanical Engineering
University of Michigan, Ann Arbor
Room 2024 GGB, katsuo@umich.edu

Class Hours:	July 23 - 25 **(**Mon/Tue/Wed)	10:30am-12:00am (90 min), Room ES032
Problem Sessions:	July 23, 24 (Mon/Tue)	1:30pm – 3:00pm (90 min), Room ES032
Final Presentation:	July 25 (Wed)	3:00pm – 5:00pm (120 min), Room ES032

Course Web: https://ctools.umich.edu
The course materials and presentations are available at the University of Michigan CTool site.

Textbooks: N/A (All the lecture materials are provided by the instructor.)

Course Description:
This intensive summer course provides a fundamental training for senior-level undergraduate and graduate students to conduct research with a full understanding of the importance of logical thinking. The objective of this course is to help students develop skills to independently define problems and design methods for performing a logically well-defined research project. The covered topics in this courser include: (a) Research planning; (b) Research implementation; (c) Research proposal/paper writing; and (d) Research presentation. At the end of this course, the students are required to make a presentation about their summer projects at Nagoya University.

Course Format:
The course has 3 morning lectures, 2 afternoon problem sessions, and 1 final presentation. The lecture entails the instructor's course material presentation and interactive discussions between the instructor and students. In the problem session, the students are asked to write a short research proposal while consulting with the instructor. Based on the instructor's advice, the students iteratively edit their writings. In the final presentation, each student makes an oral slide presentation to the class and answer questions from the audience.

Course Assignments:
The students are required to do the followings as the course assignments:

(1) Submit a 600-word report of his/her research project following the logical structure taught in the course.
(2) Prepare a PowerPoint slide briefly showing his/her research proposal.
(3) Orally present his/her research proposal in class.

These assignments are finally submitted to the students' advisors at Nagoya University for their feedback.

Course Assignment Policies:

(1) You may discuss the assignments with your classmates and instructor. But you are asked to independently prepare your report and presentation.

(2) Your assignments are collected at the end of the course and due on **July 27(Fri) at 5pm**. The assignments are turned in to both the instructor and your advisor at Nagoya University by email as electronic file attachments. No late submission, unless the student notifies the instructor one day prior to the due date. It is the instructor's discretion to accept or decline the request for late submission.

Tentative Schedule (Subject to Change):

Session	Dates	Type	Topics	Assignments
1	July 23 (Monday) 10:30-12:00am ES032	Lecture 1	Purposes of Research Research Proposal Structure Finding Research Problems Conducting Research Sample Project	Research proposal assigned
2	July 23 (Monday) 1:30-3:00pm ES032	Problem Session	Writing a research proposal Individual discussion	Informal presentation/ discussion
3	July 24 (Tuesday) 10:30-12:00am ES032	Lecture 2	Innovative design and research process -Case study: Silicon Valley Design Company, IDEO Research Paper Writing -Background/Literature Survey -Problems/Working Hypothesis -Methods/Approach -Expected Results -Research Impact	Research proposal slide assigned
4	July 24 (Tuesday) 1:30-3:00pm ES032	Problem Session	Writing a research proposal Individual discussion Slide preparation	Informal presentation/ discussion
5	July 25 (Wednesday) 10:30-12:00am ES032	Lecture 3	Key to effective research presentation How to prepare a research poster	
6	July 25 (Wednesday) 3:00-5:00pm ES032	Project Presentation	Oral presentation (10 min each) Q & A (2 min each)	
	July 27 (Friday)		**Assignments Due by 5pm**	(1) 600-word report file (2) PowerPoint slide file

2-c. Intensive Lectures

Jul. 4 (Wed) Energy Storages and Battery Overview
(Res. Lecturer Yasumasa Ito, Department of Mechanical Science and Engineering, Nagoya University)

Jul. 5 (Thu) Fuel Cell Vehicle at Honda I/ II
(Mr. Asao Uenodai, Honda Motor Co., Ltd)

Jul. 9 (Mon) Batteries for Stationary Applications
(Dr. Yo Kobayashi, Central Research Institute of Electric Power Industry)

Jul. 11 (Wed) Fuel Cell
(Dr. Takao Watanabe, Central Research Institute of Electric Power Industry)

Jul. 12 (Thu) Zinc-Anode Batteries
(Res. Lecturer Yasumasa Ito, Department of Mechanical Science and Engineering, Nagoya University)

Jul. 25 (Wed) Reactor Thermal Hydraulics and Safety
(Prof. Tomoaki Kunugi, Department of Nuclear Engineering, Kyoto University)

Jul. 26 (Thu) Development of Future Green Vehicles
(Mr. Masaki Azuma, Toyota Motor Corporation)

Jul. 30 (Mon) Future Materials for Automobiles
(Mr. Kiyoshiba Mase, Toyota Motor Corporation)

Aug. 1 (Wed) CFRP Body Development for Lexus LFA
(Mr. Manabu Ozawa, Toyota Motor Corporation)

2-d. Factory Tours

Toyota Motors Factory Visit

Date: July 27 (Fri)
Place: Toyota-city, Aichi
Plan: Plant tour of assembly shop and welding shop
Tour of Toyota Kaikan Museum

Mitsubishi Motors Factory Visit

Date: August 2 (Thu)
Plce: Okazaki-city, Aichi
Plan: Plant tour of painting and vehicle section
Heat lab, aerodynamics lab and M-Tech lab tour
i-MiEV ride

2-e. Internship & Workshop

	Name	Research Theme	Advisor at Nagoya University
1	**Pattarawit Sae-Ong**	Ultra-high pressure synthesis and properties of energy-related materials	Prof. Masashi Hasegawa
2	**Syed Talha Wasif**	Uncertainty quantification of fission product inventories of nuclear fuel due to numerical modeling	Prof. Akio Yamamoto
3	**Yu Ning**	Development of crack healing technique for metals	Prof. Yang Ju
4	**Lu-Yin Wang**	Scalar mixing in regular and fractal grid turbulence	Assoc. Prof. Kouji Nagata
5	**Mudit Rastogi**	Development of non-destructive inspection system using neutron and gamma detectors	Prof. Tetsuo Iguchi
6	**Sajeev Gulyani**	Photovoltaic/thermoelectric hybrid solar cell	Prof. Kunihito Koumoto
7	**Nanda Gopalan Venkata Ramanan**	Ulta low friction coating for high efficient advanced automobile	Prof. Noritsugu Umehara
8	**Sean Triputra Bong**	Design of renewable energy-based resilient electric power system	Assoc. Prof. Takeyoshi Kato
9	**Qiongyu Lou**	What the next-generation large-scale battery to be?	Res. Lecturer Yasumasa Ito

The 2nd JUACEP Workshop

Date: 13:20-16:30, August 30, 2012

Venue: Room 103, ES Building, Nagoya University

~Presentation Title~

1. Pattarawit Sae-Ong (P.18)

Preparation of Diamond Crystals using High Pressure & High Temperature

2. Syed Talha Wasif (P.25)

Uncertainty Quantification of Fission Product Inventories

3. Yu Ning (P.40)

The best current condition for crack healing

4. Lu-Yin Wang (P.52)

Scalar Mixing in Regular and Fractal Grid Turbulence

5. Mudit Rastogi (P.57)

Non Destructive Inspection System Using Neutron and Gamma Imaging Detectors

6. Sajeev Gulyani (P.71)

Dye Sensitized Solar Cells and Photovoltaic-Thermoelectric Hybrid Device

7. Nanda Gopalan Venkata Ramanan (P.88)

Friction and Wear Analysis on DLC Specimen Using Automotive Grade Oil and Additives

8. Sean Triputra Bong (P.95)

Demand Load Forecasting and Battery Scheduling Optimization

9. Qiongyu Lou (P.104)

Next-Generation Batteries for Stationary Applications

Preparation of

Diamond Crystals

using High Pressure & High Temperature

: Pattarawit Sae-Ong :

Prof. Hasegawa's Laboratory, Department of Crystalline Materials Science

JUACEP 2012 Program at Nagoya University

August 30, 2012

Presentation Outline

1. Introduction
   - Problem identified
   - Diamond synthesis
   - Objective
2. Research methodology
3. Results
   - Starting material
   - Recovered sample (2 min.)
   - Recovered sample (20 min.)
4. Discussion & conclusions

Introduction: Problems identified

Outstanding properties of diamond

Wide-gap semiconductor

High thermal conductivity

Hardest material

In **EVs**, **power electronic devices** are used in many systems.

- High performance semiconductors are required.
- Large amount of generated heat needs to be managed.

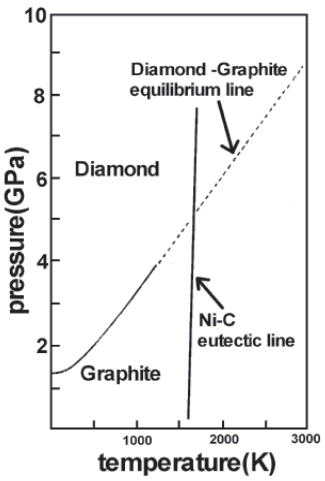
Diamond

High performance wide-gap semiconductor

High performance thermal conductor

- ✓ Efficient power electronic devices with compact size
- ✓ Excellent heat dissipation
- ✓ Resolve the recent critical concerns in EV applications

Introduction: Diamond Synthesis



2 Main Techniques

- ❖ **High pressure & high temperature (HPHT)**
  - Bulky crystals
  - High quality
  - Fast growth process
- ❖ **Chemical vapor deposition (CVD)**
  - Thin-film
  - Slow growth process

Introduction: Objective

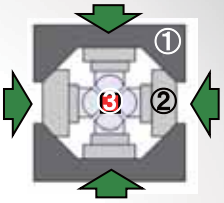
This research aims

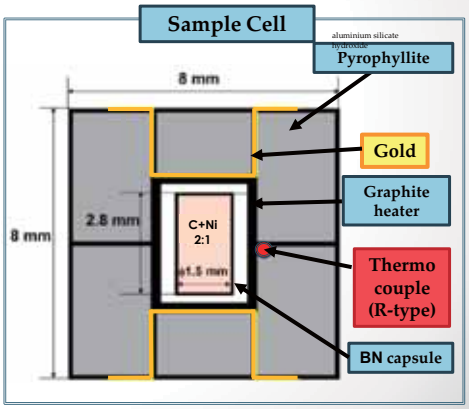
to prepare high-quality diamond crystals for power device applications using HPHT technique

Research Methodology

DIA type high pressure apparatus

1. Guide blocks
2. Side blocks
3. Sample cell

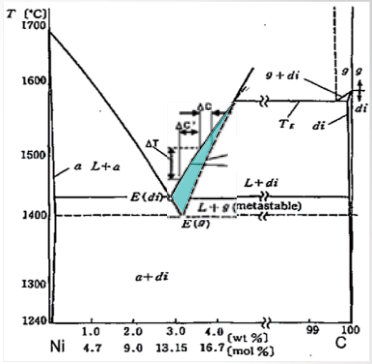




Research Methodology

5.5 GPa / 1400 °C

Formation of Diamond Crystals



Characterization: SEM-EDS
Scanning Electron Microscopy / Energy Dispersive Spectrometry

- **Starting material**
  Graphite:Ni = 2:1
- **Condition**
  5.5 GPa / 1400 °C
- **Holding time**
  2 min. & 20 min.

Results

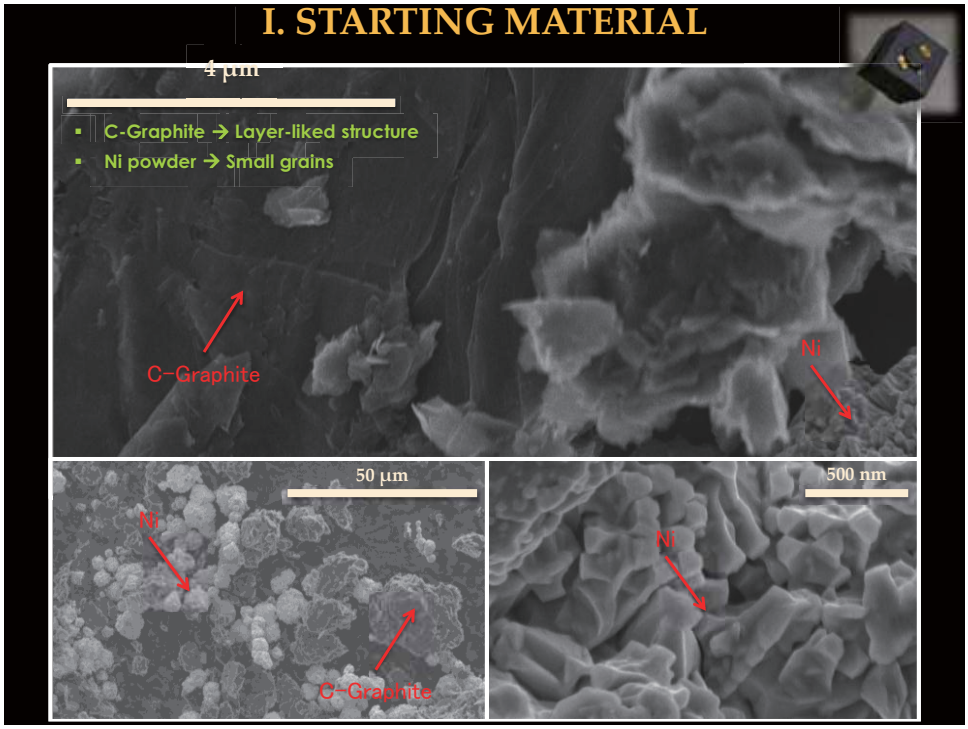
SEM-EDS

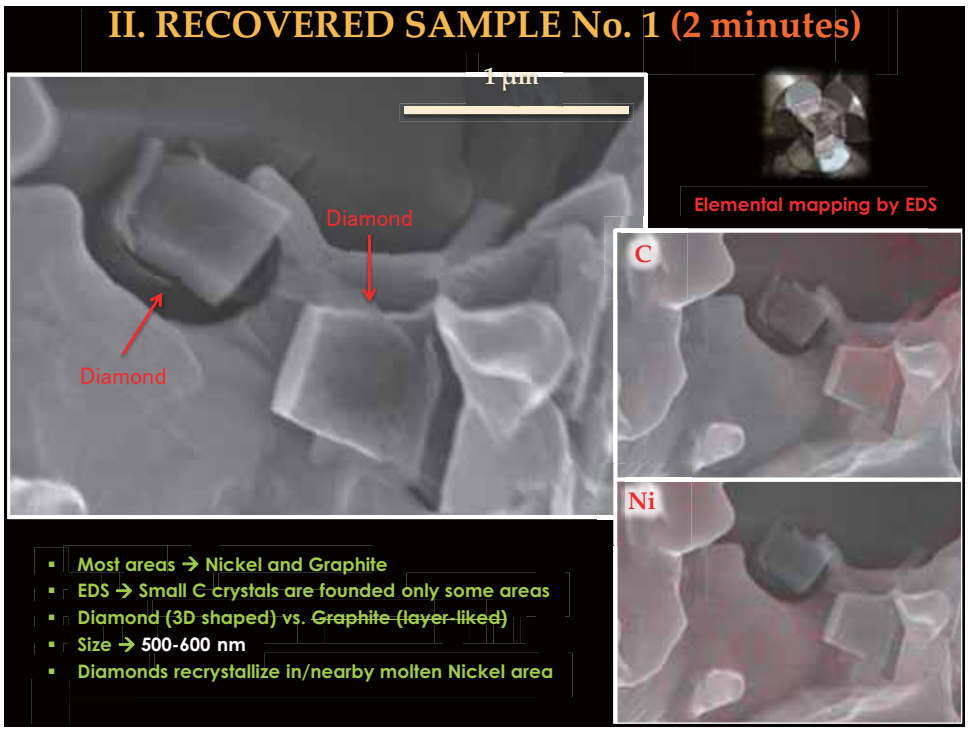
Scanning Electron Microscopy / Energy Dispersive Spectrometry

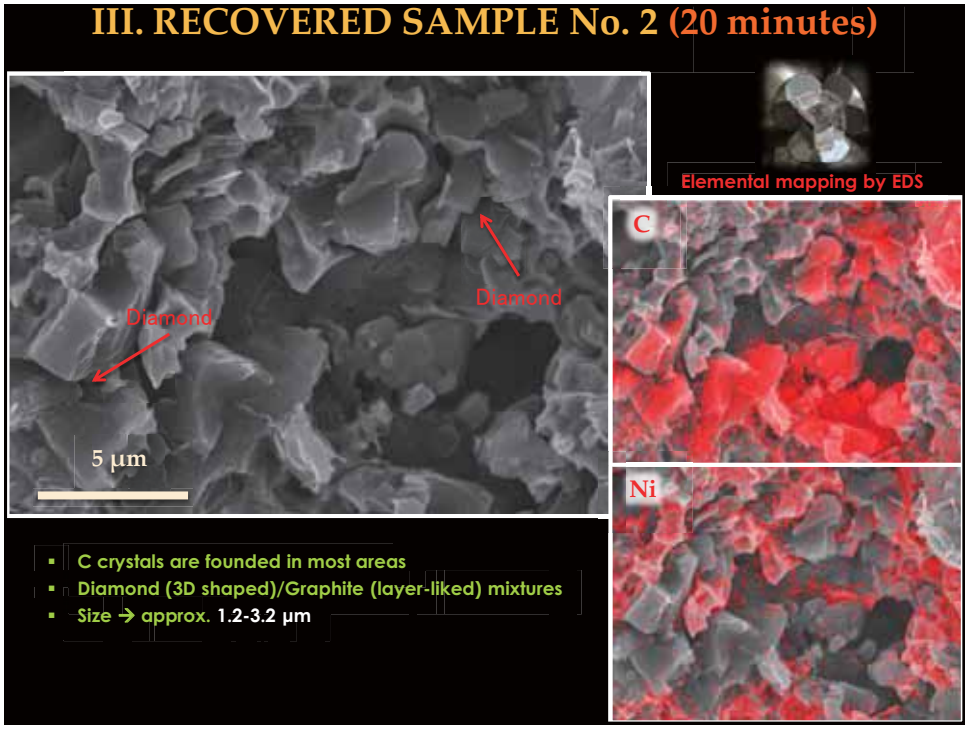
I. Starting Material

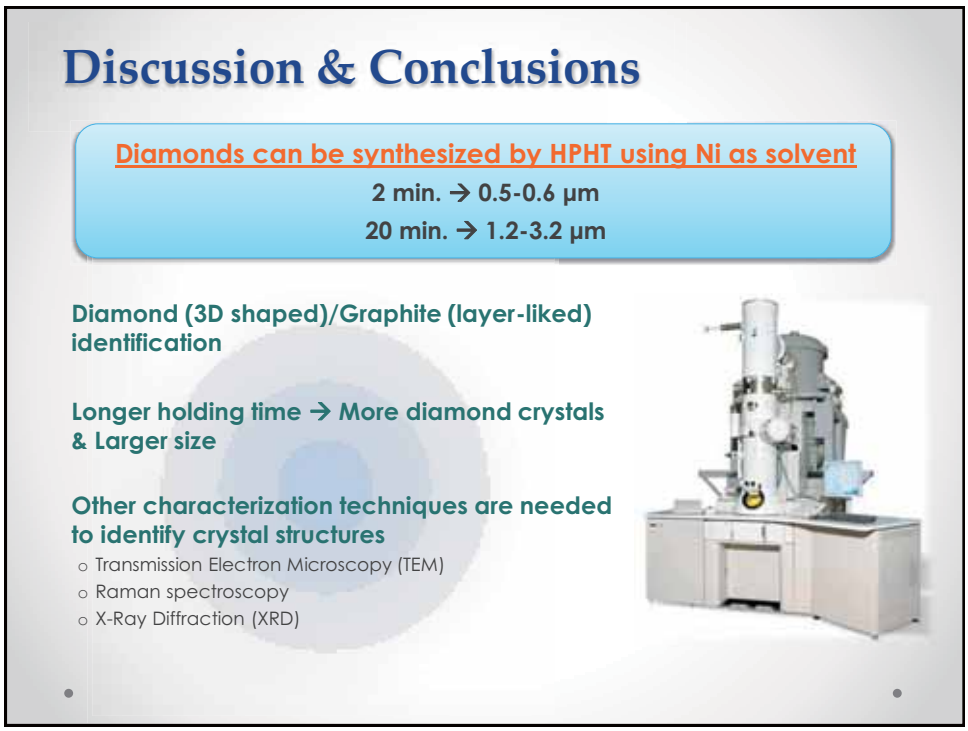
II. Recovered Sample No. 1
(2 minutes)

III. Recovered Sample No. 2
(20 minutes)


I. STARTING MATERIAL
4 μm
C-Graphite → Layer-liked structure
Ni powder → Small grains
C–Graphite
Ni
50 μm
Ni
C–Graphite
500 nm
Ni


II. RECOVERED SAMPLE No. 1 (2 minutes)
1 μm
Diamond
Diamond
Elemental mapping by EDS
C
Ni
Most areas → Nickel and Graphite
EDS → Small C crystals are founded only some areas
Diamond (3D shaped) vs. Graphite (layer-liked)
Size → 500-600 nm
Diamonds recrystallize in/nearby molten Nickel area


III. RECOVERED SAMPLE No. 2 (20 minutes)
Diamond
Diamond
5 µm
Elemental mapping by EDS
C
Ni
C crystals are founded in most areas
Diamond (3D shaped)/Graphite (layer-liked) mixtures
Size → approx. 1.2-3.2 µm


Discussion & Conclusions
Diamonds can be synthesized by HPHT using Ni as solvent
2 min. → 0.5-0.6 µm
20 min. → 1.2-3.2 µm
Diamond (3D shaped)/Graphite (layer-liked) identification
Longer holding time → More diamond crystals & Larger size
Other characterization techniques are needed to identify crystal structures
Transmission Electron Microscopy (TEM)
Raman spectroscopy
X-Ray Diffraction (XRD)


Thank you
Do you have any questions?
: Pattarawit Sae-Ong :
Prof. Hasegawa's Laboratory, Department of Crystalline Materials Science
JUACEP 2012 Program at Nagoya University
August 30, 2012

Uncertainty Quantification of Fission Product Inventories

Professor Yamamoto Lab
Materials, Physics & Energy Engineering
Nagoya University

Background

- Tohoku Earthquake – 11th March, 2011
- Fukushima Dai-ichi facts.
- Extreme temperatures inside reactor core.
- Hydrogen production & subsequent explosion.
- Dispersion of radioactive isotopes.
- Current state of radiation.
- Damage Assessment.

Need Statement

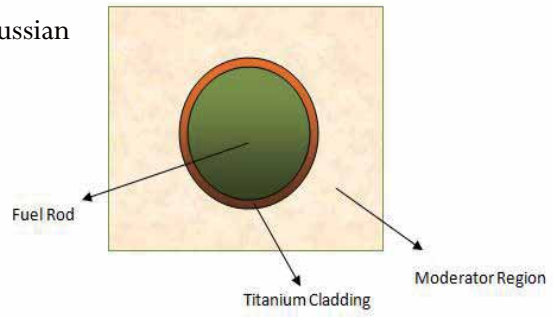
- Experimental analysis.
- The need for numerical methods.
- Such calculations tend to introduce errors in the output.
- 2 major sources of uncertainty:
  - Uncertainty in input data.
  - Uncertainty due to numerical modeling.

Objective

- To assess the nature of error propagation in nuclear depletion equation solution.
- To obtain output distribution in response to a given input distribution.
- Attempt to form an empirical relationship between the input uncertainty & obtained results.

Method

- Depletion equation calculations are done using SRAC2006 Code.
- No. of Data Points: 1,000
- Input Distribution: Gaussian



Uncertainty Parameters

- Fuel Enrichment Percentage
- Void Fraction of Moderation
- Core Power

Method

- Output calculations being considered are:
  - Nuclide Densities (19 Nuclei Considered)
- Random Sampling based Monte Carlo approach is being used.
- A set of random numbers (1000) is generated with normal distribution. (Relative S.D <=5%)
- SRAC Input files are generated for each of the 1000 cases.
- Different statistical parameters are obtained (Variance, Standard Deviation, Covariance etc.)
- Output distribution is obtained by plotting histograms.

Preliminary Analysis

- A preliminary UQ analysis was carried out by analytically solving depletion equations for (Cs-134 & Cs-137 nuclides) and then obtaining the ratio Cs-134/Cs-137
- Cs-134 cross-section, Cs-137 cross-section and neutron flux was individually perturbed on 10,000 data points with SD = 0.1
- Subsequently, Cs-134 and Cs-137 cross-sections were simultaneously perturbed to obtain the results.

Preliminary Analysis

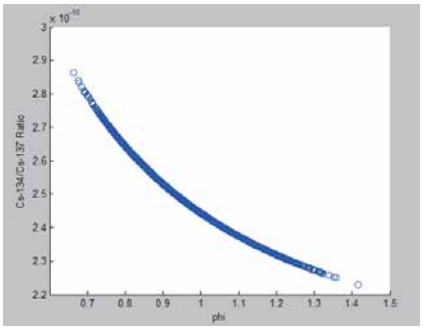


Fig. 1: Effect of Neutron Flux Uncertainty on Cs-134/Cs-137 Ratio

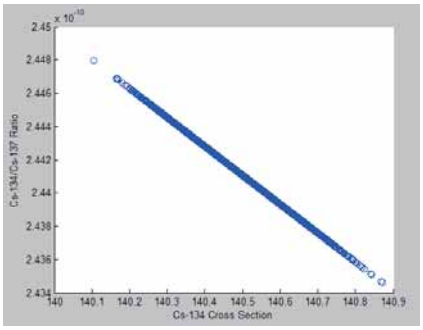


Fig. 2: Effect of Cs-134 Cross-Section Uncertainty on Cs-134/Cs-137 Ratio

Preliminary Analysis

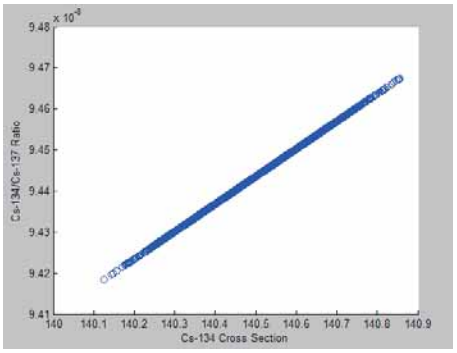


Fig. 3: Effect of Cs-137 Cross-Section Uncertainty on Cs-134/Cs-137 Ratio

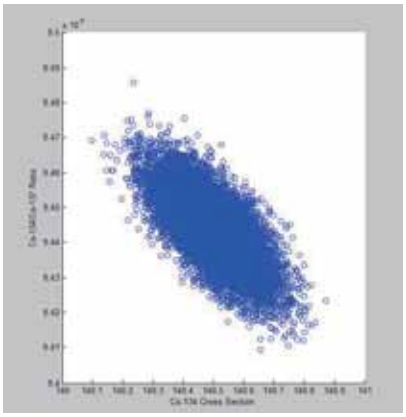
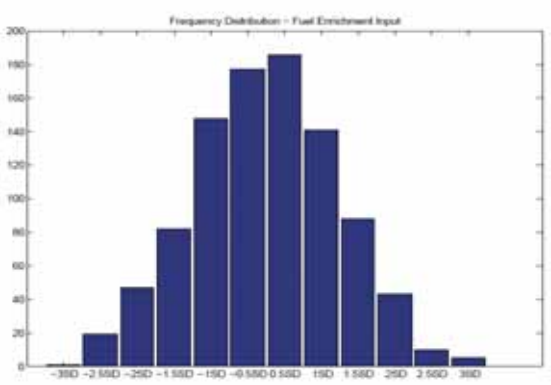


Fig. 4: Effect of Cs-134 & Cs-137 Cross-Section Uncertainties on Cs-134/Cs-137 Ratio

Uncertainty Due to Fuel Enrichment

- Data Points: 952
- Mean Enrichment: 3.7%
- Standard Deviation: 0.1
- Relative Standard Deviation: 2.67%



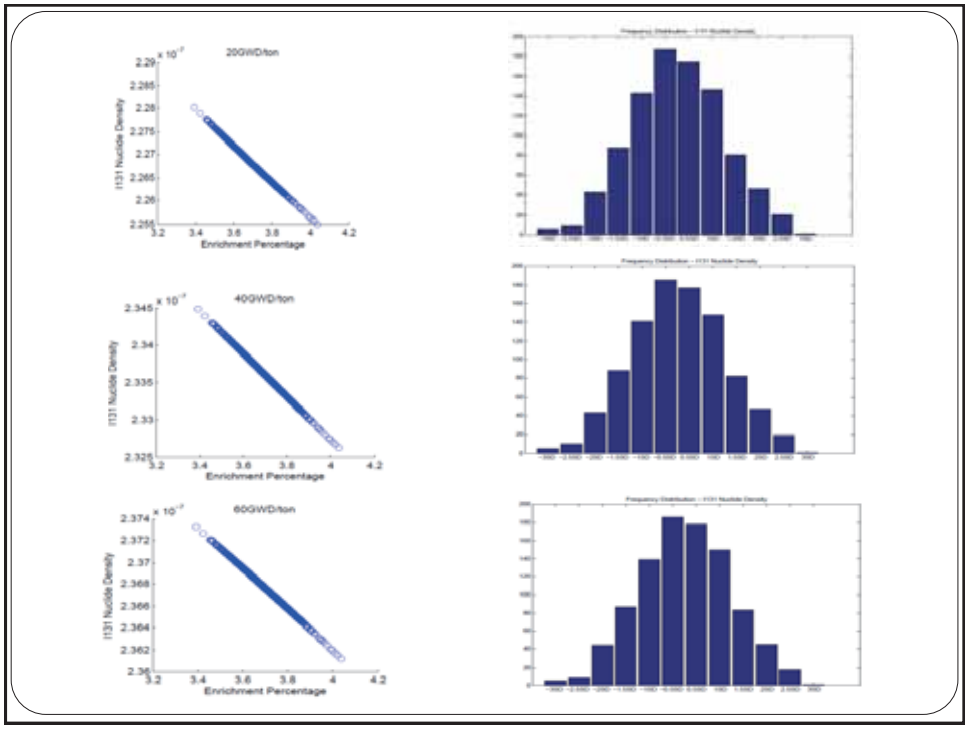
$$\Phi_U = \frac{\frac{E.P}{100} M_{U-235} + \frac{100 - E.P}{100} M_{U-238}}{\frac{E.P}{100} M_{U-235} + \frac{100 - E.P}{100} M_{U-238} + 2M_{O16}}$$

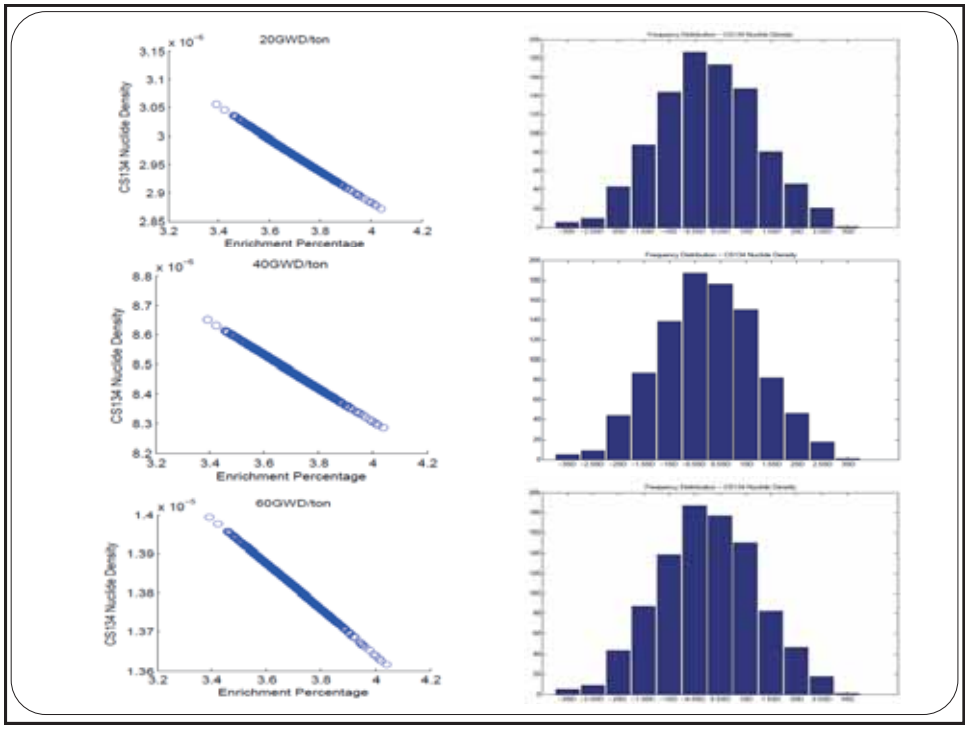
$$\Phi_U = \frac{2M_{O16}}{\frac{E.P}{100} M_{U-235} + \frac{100 - E.P}{100} M_{U-238} + 2M_{O16}}$$

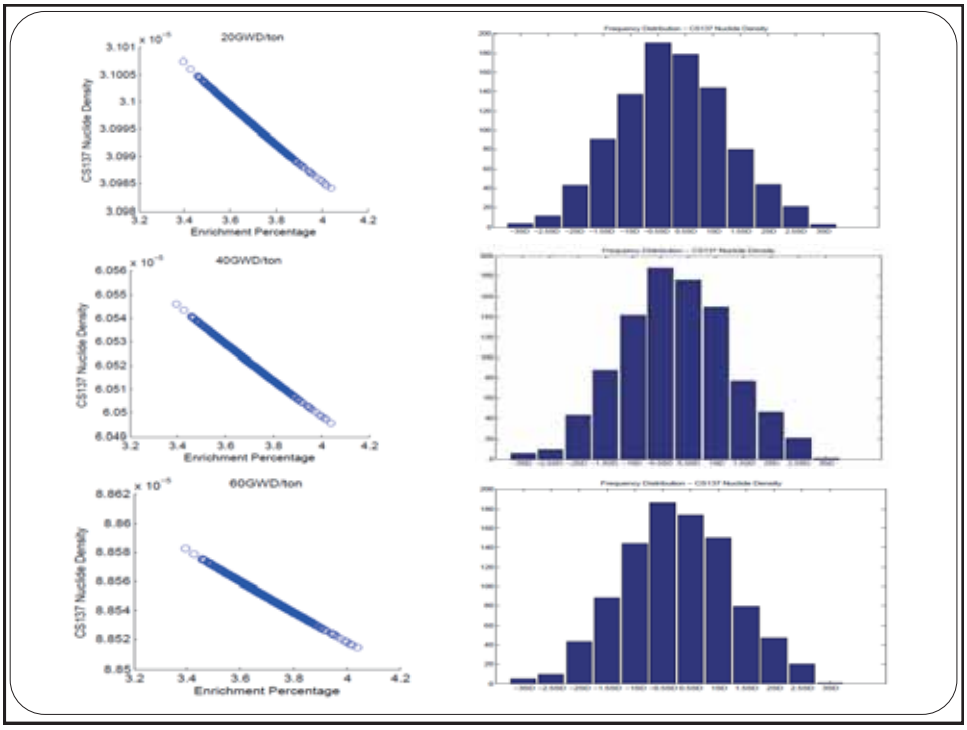
$$\mu_{U235} = \frac{N_A * \varrho * \Phi_U * \frac{EP}{100}}{M_{U-235}}$$

$$\mu_{U238} = \frac{N_A * \varrho * \Phi_U * \frac{100 - EP}{100}}{M_{U-238}}$$

$$\mu_{O16} = \frac{N_A * \varrho * \Phi_U * \frac{100 - EP}{100}}{M_{O16}}$$


20GWD/ton
40GWD/ton
60GWD/ton
I131 Nuclide Density
Enrichment Percentage


20GWD/ton
40GWD/ton
60GWD/ton
CS134 Nuclide Density
Enrichment Percentage



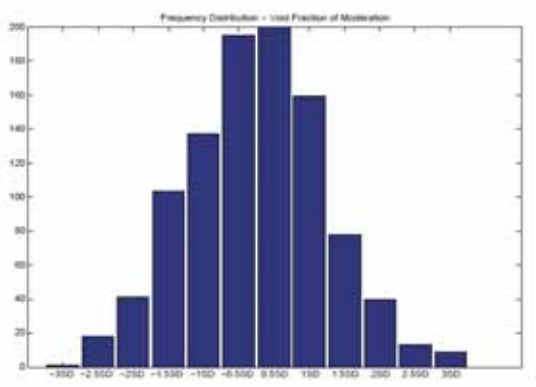
	Enrichment	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
Mean	3.698%	2.27e-7	2.96e-6	3.09e-5
Standard Deviation	0.098	3.87e-10	2.82e-8	3.56e-9
Relative Standard Deviation	2.67%	0.17%	0.95%	0.0115%

Covariance @	Enrichment	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
20GWD/ton	+	-(0.002%)*	-(0.15%)	-(0.02%)
40GWD/ton	+	-	-	-
60GWD/ton	+	-	-	-

*Percentage of Strongest Covariance Nuclide: U238 (Negative)

Uncertainty Due to Void Fraction of Moderation

- Data Points: 998
- Mean Value: 39.94%
- Standard Deviation: 1.49
- Relative Standard Deviation: 4%



Relevant Equations

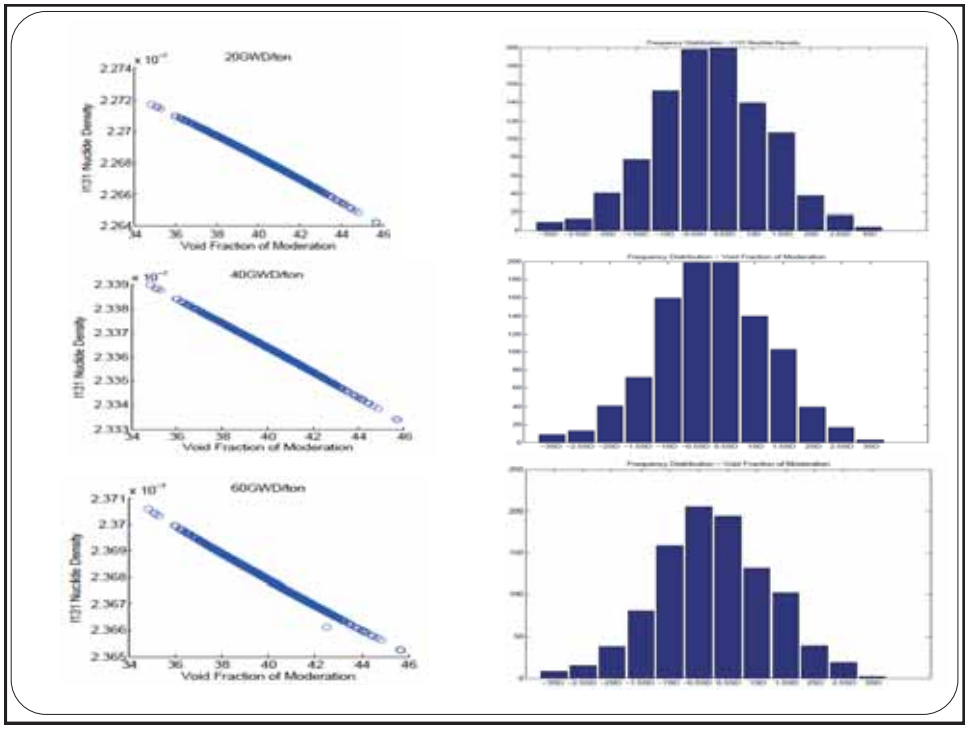
$$\varrho = \varrho_0 \frac{x}{100} + \varrho_{100} \frac{100 - VF}{100}$$

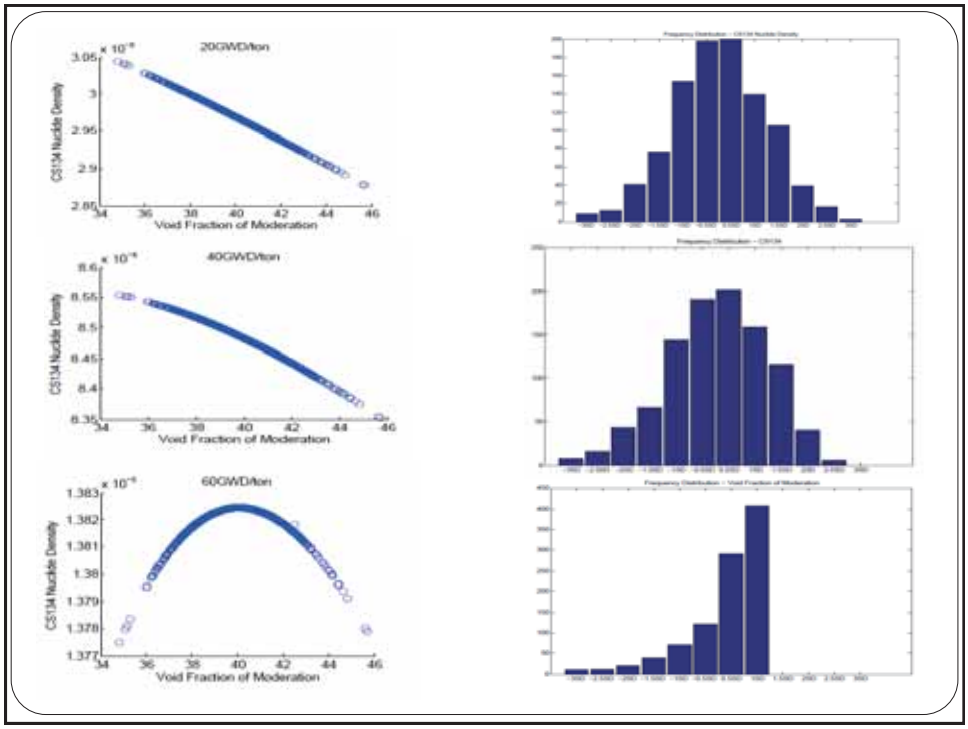
$$\Phi_H = \frac{2M_H}{2M_H + M_O} X100$$

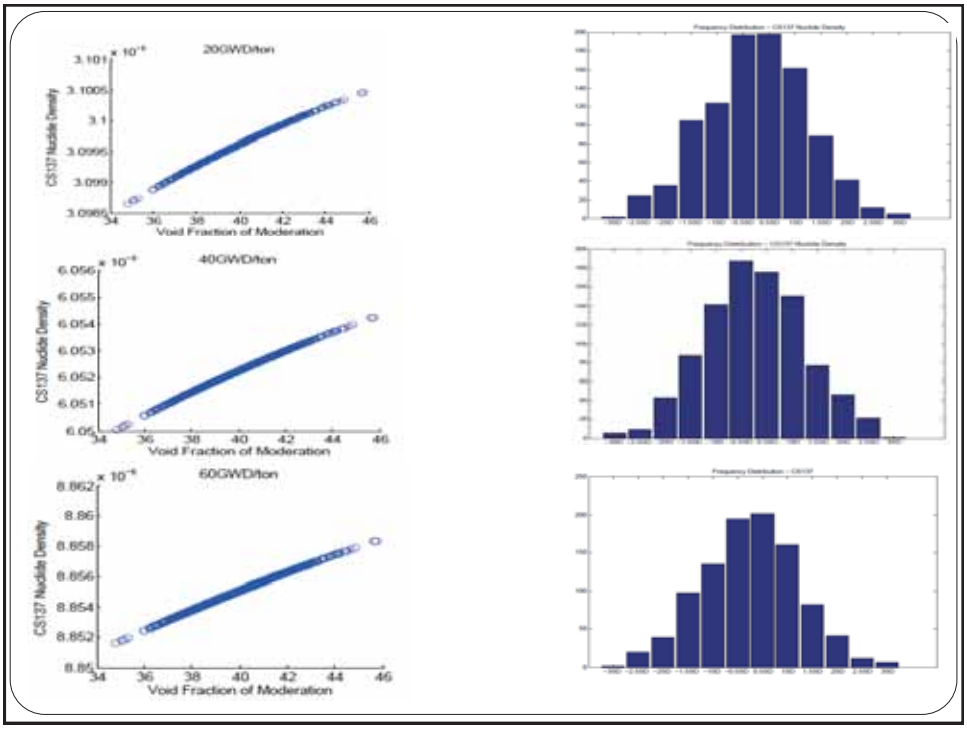
$$\Phi_O = \frac{2M_O}{2M_H + M_O} X100$$

$$\mu_H = \frac{N_A \, \varrho \, \Phi_H}{M_H * 1e24}$$

$$\mu_O = \frac{N_A \, \varrho \, \Phi_O}{M_O * 1e24}$$


20GWD/ton
40GWD/ton
60GWD/ton
I131 Nuclide Density
Void Fraction of Moderation


20GWD/ton
40GWD/ton
60GWD/ton
CS134 Nuclide Density
Void Fraction of Moderation



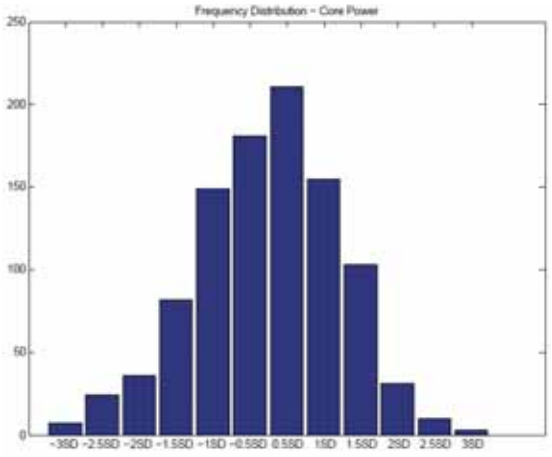
	Void Fraction	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
Mean	39.94%	2.26e-7	2.97e-6	3.2e-5
Standard Deviation	1.59	1.1e-10	2.46e-8	2.69e-9
Relative Standard Deviation	4%	0.05%	0.83%	0.0087%

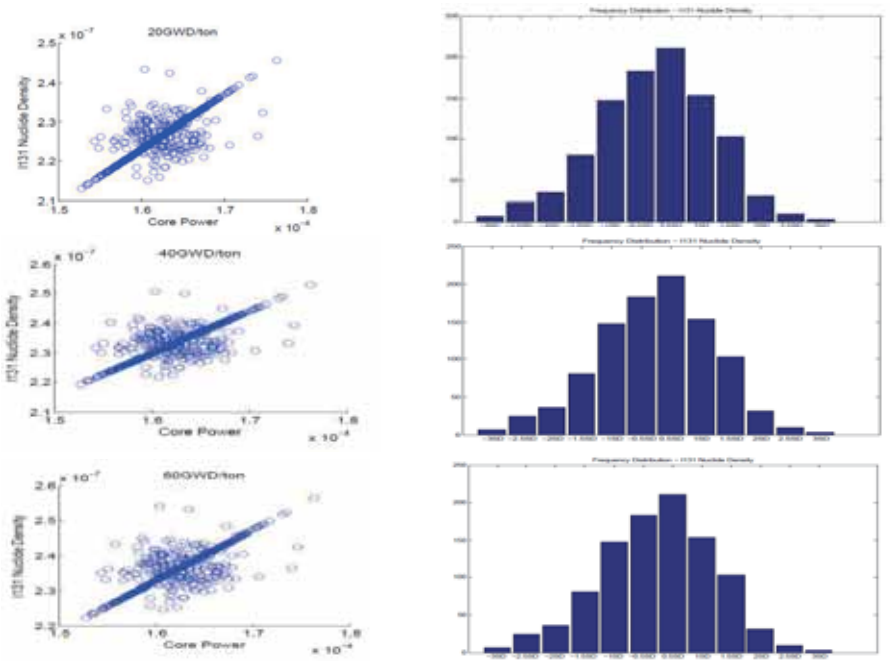
Covariance @	Void Fraction	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
20GWD/ton	+	-(0.0011%)	-(0.24%)	+(0.0258%)
40GWD/ton	+	-	-	+
60GWD/ton	+	-	-	+

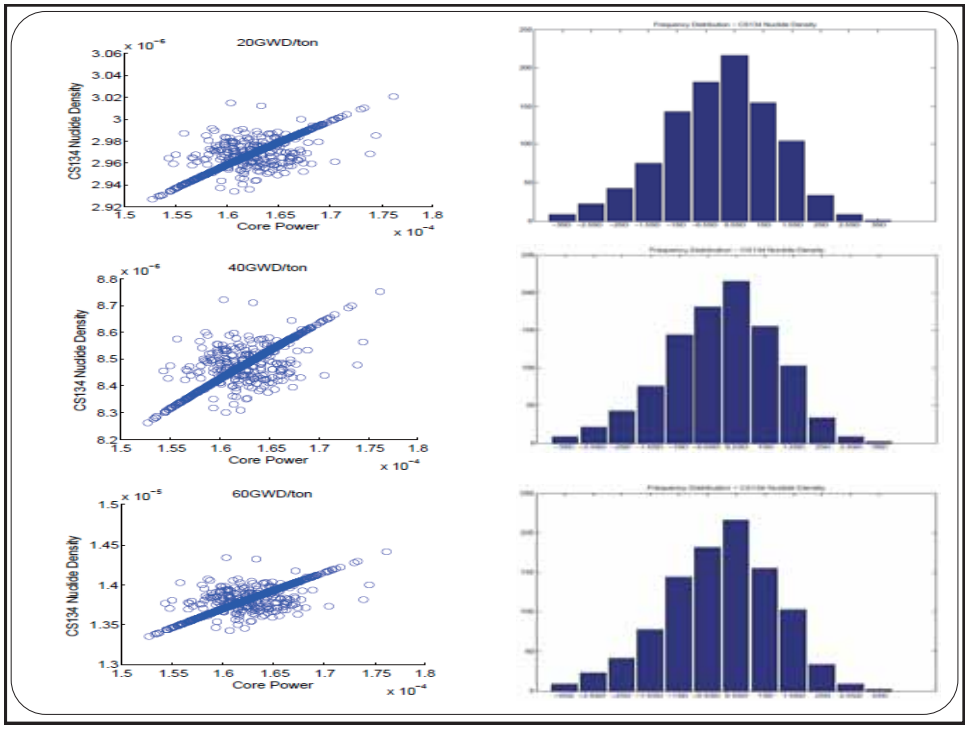
*Percentage of Strongest Covariance Nuclide: U238 (Negative)

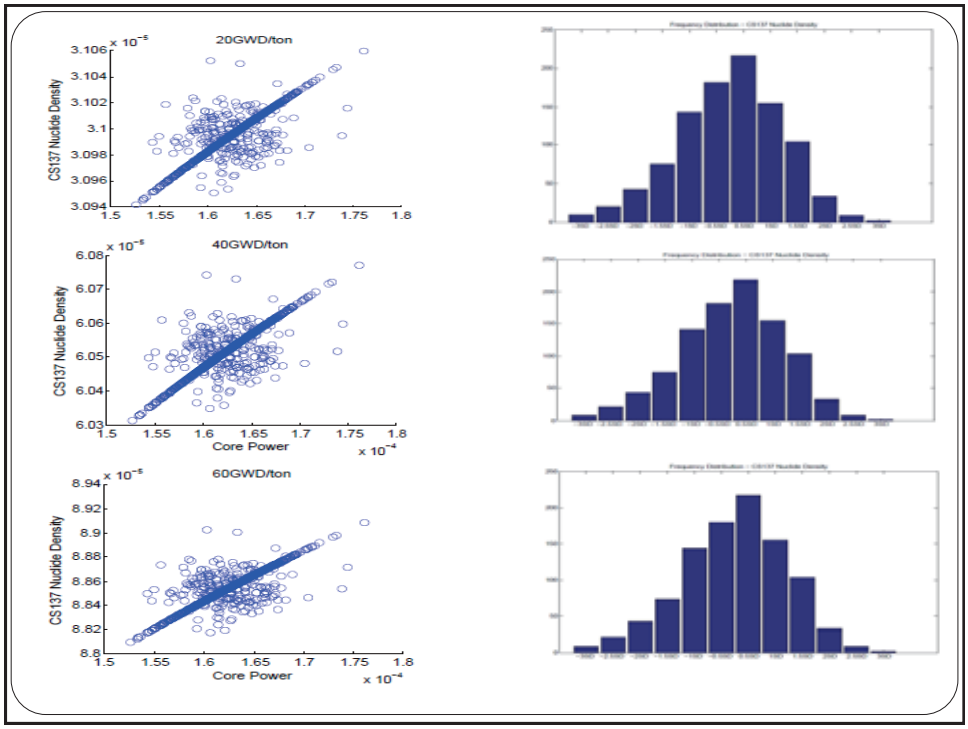
Uncertainty Due to Core Power

- Data Points: 1000
- Mean Value: 1.62e-4 MWt/cm
- Standard Deviation: 3.27e-6
- Relative Standard Deviation: 2%






20GWD/ton
40GWD/ton
60GWD/ton
CS134 Nuclide Density
Core Power
x 10⁻⁴


20GWD/ton
40GWD/ton
60GWD/ton
CS137 Nuclide Density
Core Power
x 10⁻⁴

	Core Power	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
Mean	1.62e-4	2.26e-7	2.97e-6	3.09e-5
Standard Deviation	3.27e-6	4.55e-9	1.32e-8	1.67e-8
Relative Standard Deviation	2.01%	2.00%	0.44%	0.55%

Covariance @	Core Power	I-131 Nuclide Density	Cs-134 Nuclide Density	Cs-137 Nuclide Density
20GWD/ton	+	+(4.08%*)	+(11.9%)	+(11.9%)
40GWD/ton	+	+	+	+
60GWD/ton	+	+	+	+

*Percentage of Strongest Covariance Nuclide: U238 (Negative)

Conclusions & Further Work

- Covariance values among nuclide densities are very small ($\sim 10^{-6}$).
- Almost all obtained distributions are Gaussian with very few exceptions.
- For selected nuclides, densities are seen to be most sensitive to perturbations in Core Power.

Parameter	Relative Standard Deviation Ratio		
	I131	Cs-134	Cs-137
Fuel Enrichment	0.063	0.355	0.004
Void Fraction	0.0125	0.2075	0.002175
Core Power	0.995	0.22	0.275

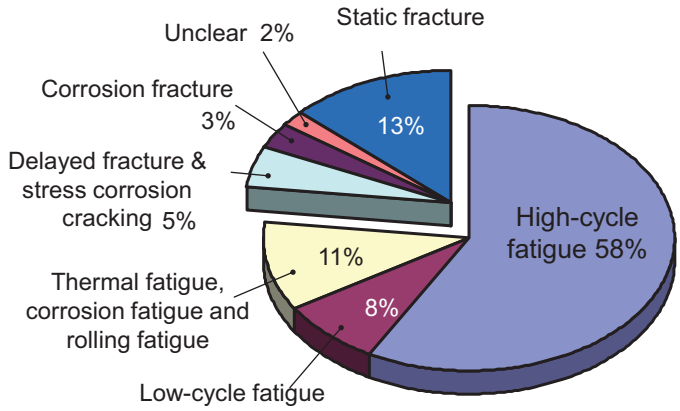
Conclusions & Further Work

- Random sampling approach applied, can prove to be computationally expensive for large data sets.
- Sophisticated, derivative based methods can be employed:
  - Forward Sensitivity Analysis
  - Adjoint Sensitivity Analysis
  - (http://www.inl.gov/technicalpublications/Documents/4074874.pdf)
- Numerical sources of uncertainty should be taken into account in addition to the physical sources.

The best current condition for crack healing

Yu Ning (University of Michigan)
Tomoya Kishi (Nagoya University)
Professor Ju Yang (Nagoya University)

Background



Causes of failure accident in metal materials

It is necessary to reduce failure accident induced by fatigue.

Objectives

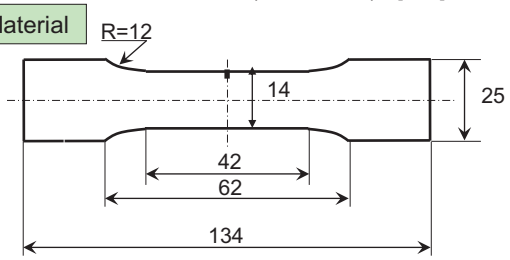
- 1.Healing pattern for different current.
- 2.Healing speed for different current.
- Find out the best current condition.

Method: 1 Polish

- Coarse polish
  Smooth polish

Austenite stainless steel (SUS316NG) [mm]

Material



Notch length: 2.0 Notch radius: 0.25 | t = 2

Condition of surface polish

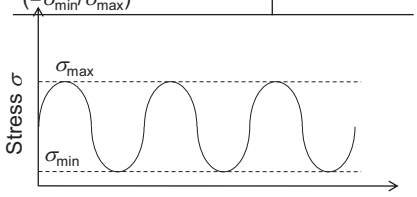
<Mirror surface finishing>
Emery paper：～#2000
Buffing：1～0.05 μm (Alumina powder)
Colloidal polishing

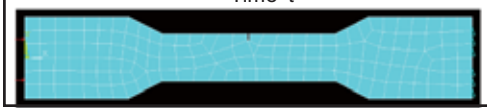
Method: 2.Introduce crack

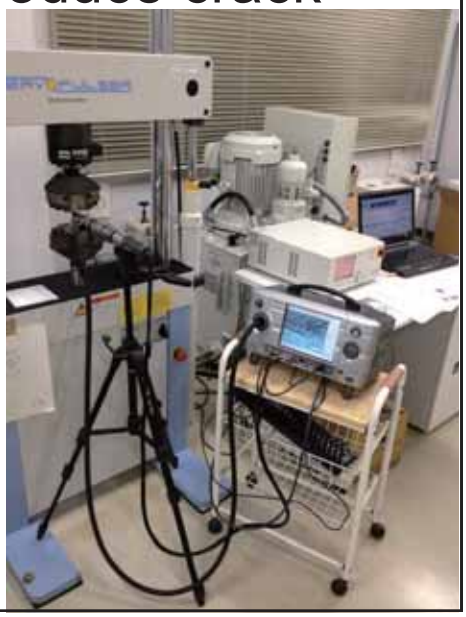
- Right: displacement 0
- Left : sine wave force

Fatigue test conditions

Maximum stress [MPa]	112
Frequency f [Hz]	10
Stress ratio R ($=\sigma_{min}/\sigma_{max}$)	0.05

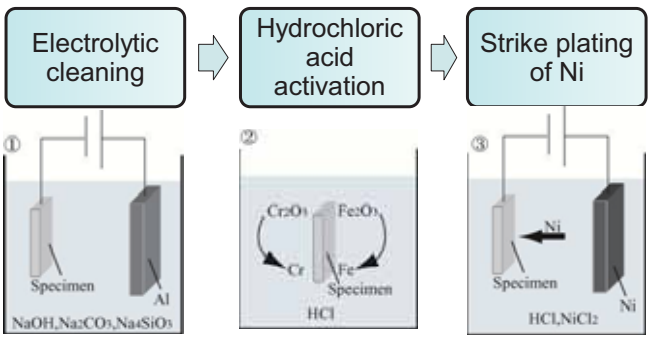


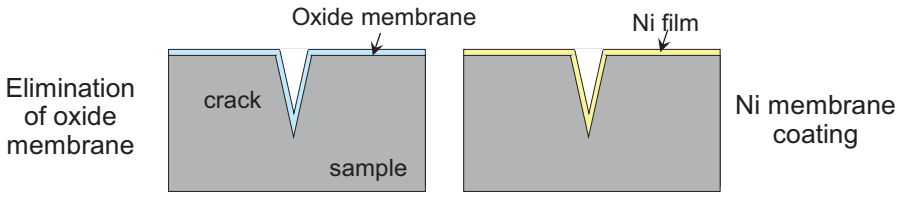




Method: 3 Coating

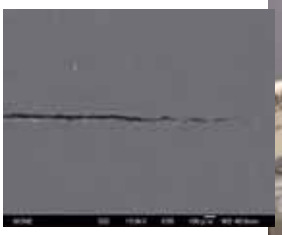
- Purpose: Ni film coating for reoxidation prevention



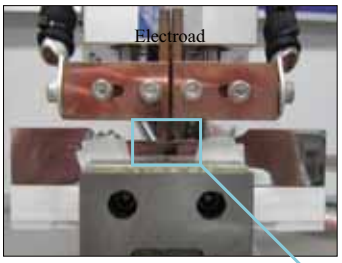


Method: 4. Observe Crack

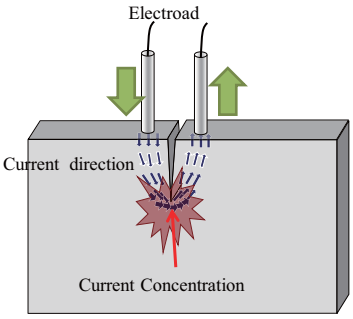
- SEM (Scanning Electron Microscope)
- Magnify
- Observe
- Shashin o tori masu.



Method: 5 Apply current



Apply current



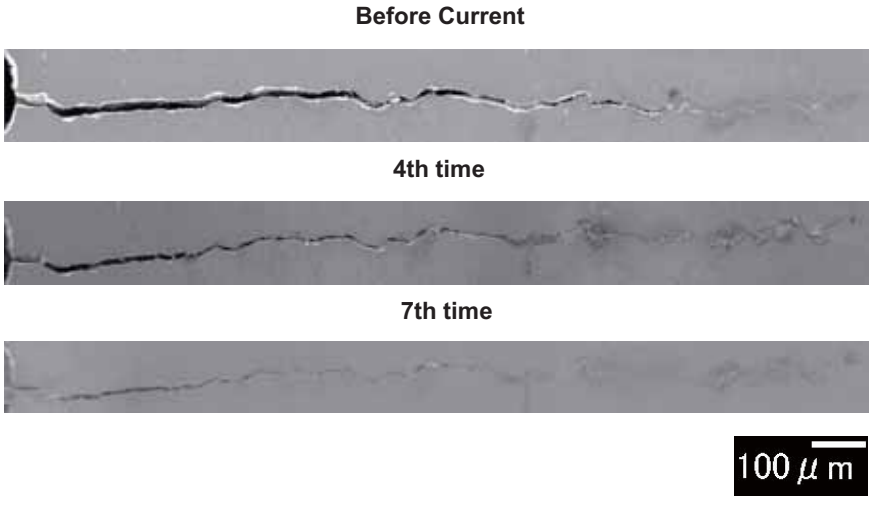
High-density current

closely placed electrode

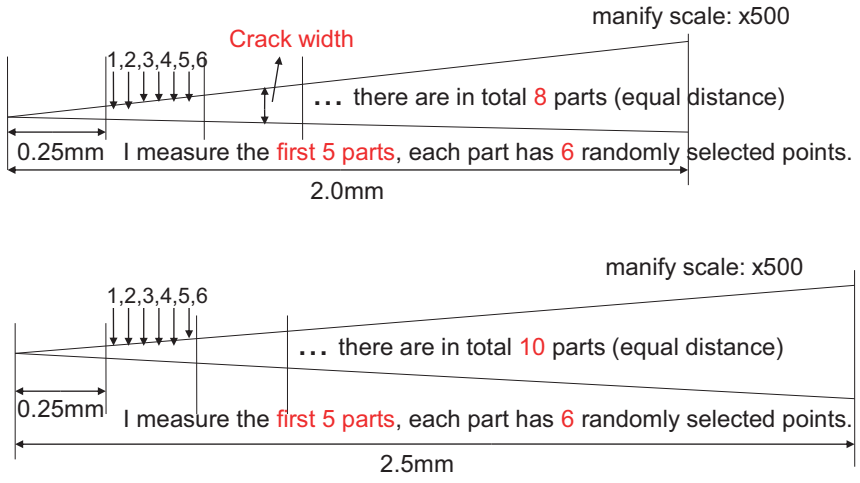
Condition of samples

Sample NO.	crack length, mm	current, kA	duration, ms	chemical time, s
3	2.5	6	2	60
4	2.5	4	3	60
6	2	4	2	60
8	2	8	2	60

6kA_2ms_2.5mm

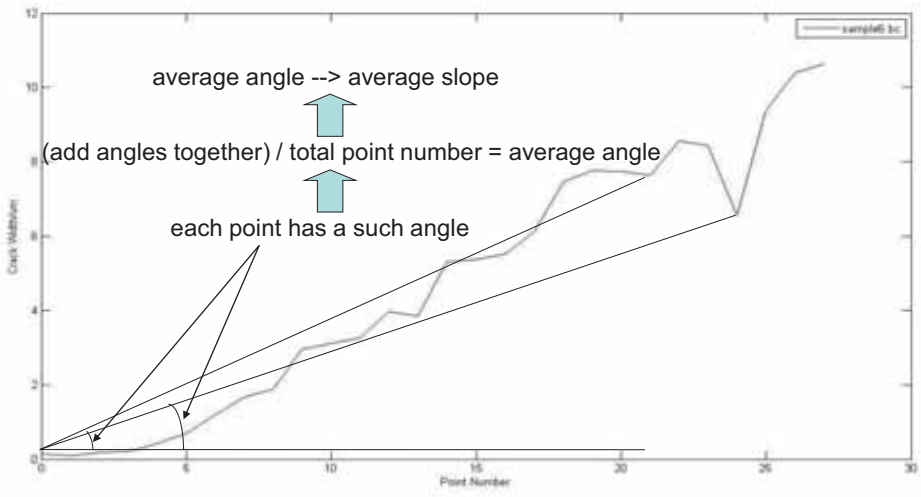


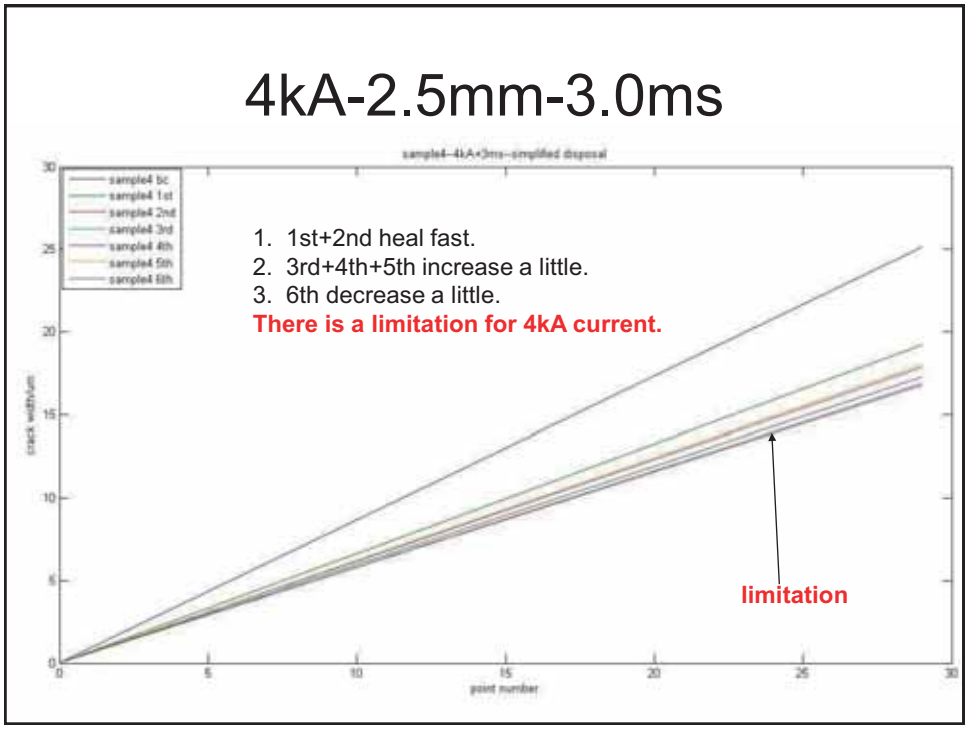
How I measure the points?

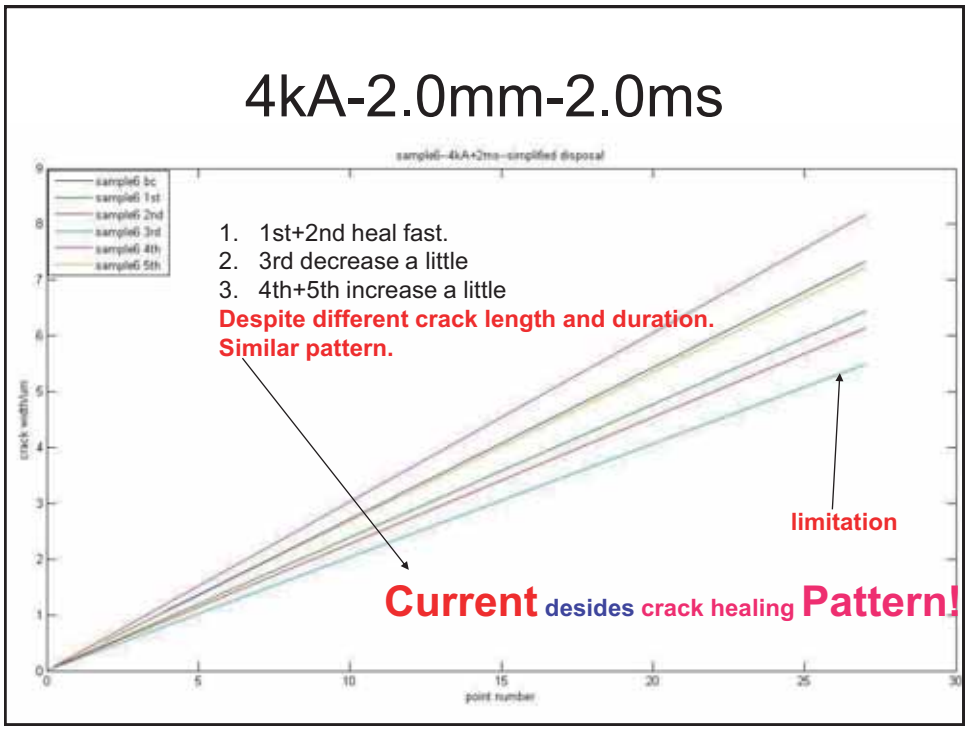


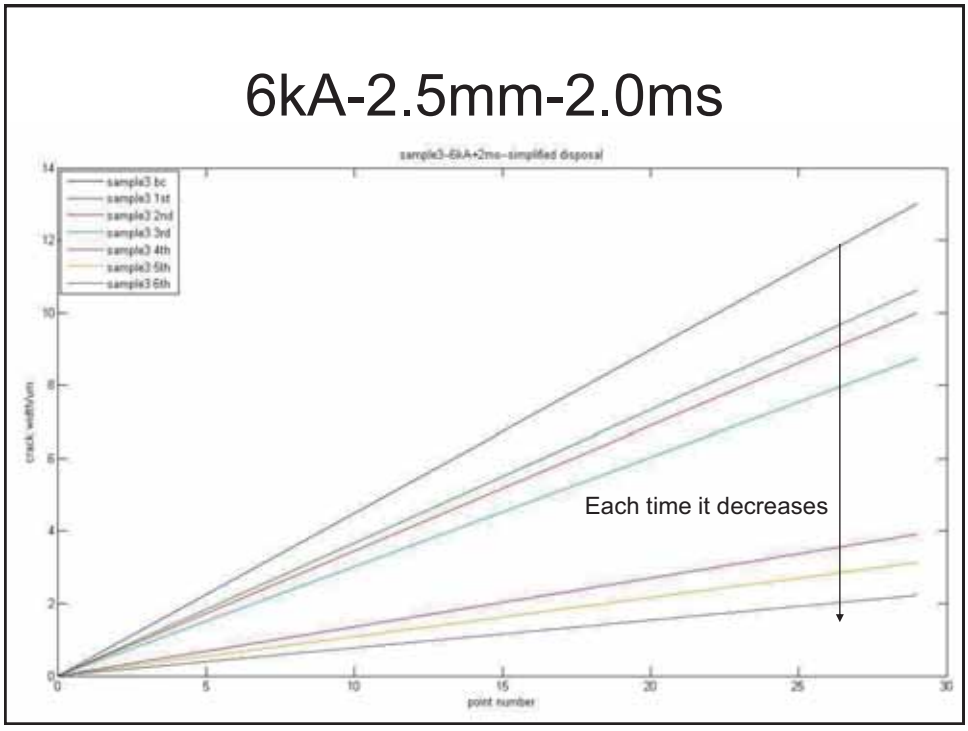
1st content

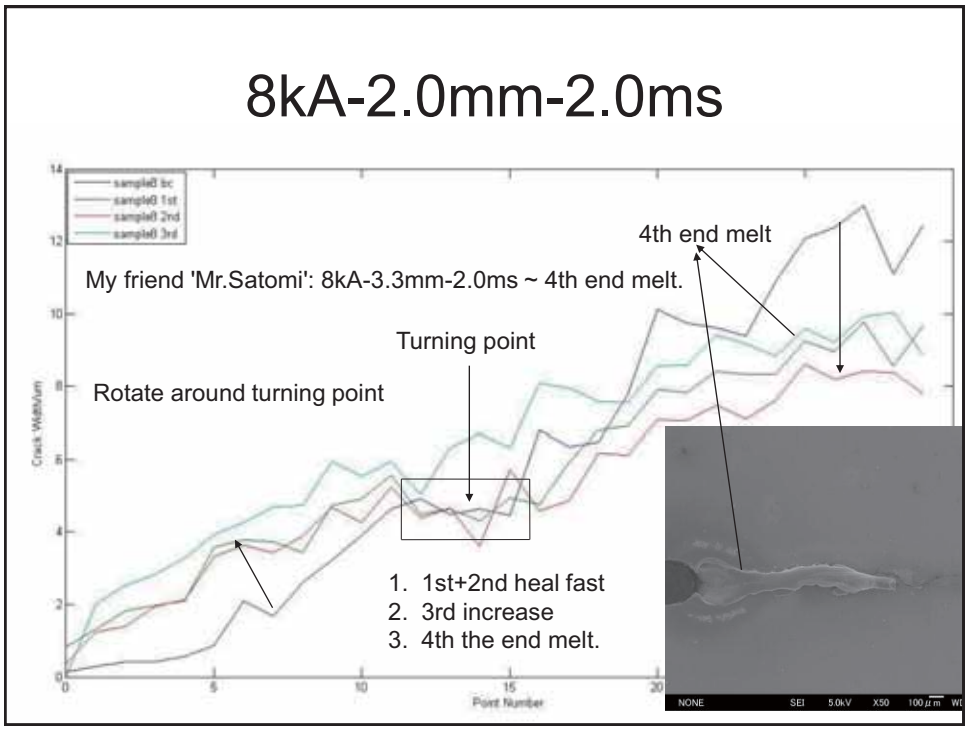
- **Current** decides healing **pattern**.




4kA-2.5mm-3.0ms
1. 1st+2nd heal fast.
2. 3rd+4th+5th increase a little.
3. 6th decrease a little.
There is a limitation for 4kA current.
limitation
point number

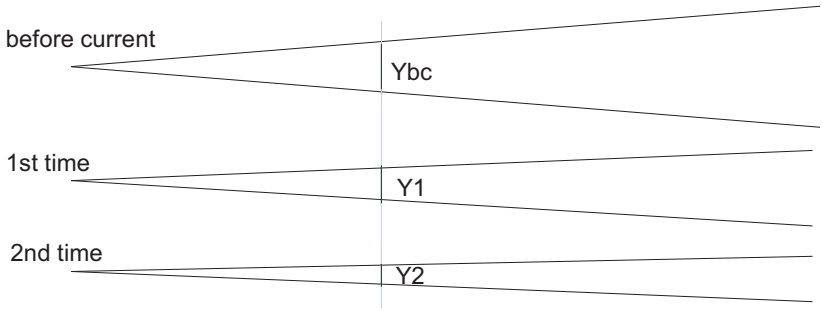

4kA-2.0mm-2.0ms
1. 1st+2nd heal fast.
2. 3rd decrease a little
3. 4th+5th increase a little
Despite different crack length and duration.
Similar pattern.
limitation
Current desides crack healing Pattern!
point number


6kA-2.5mm-2.0ms
sample3-6kA+2mo--simplified disposal
sample3 bc
sample3 1st
sample3 2nd
sample3 3rd
sample3 4th
sample3 5th
sample3 6th
crack width/um
point number
Each time it decreases


8kA-2.0mm-2.0ms
sample8 bc
sample8 1st
sample8 2nd
sample8 3rd
Crack Width/um
Point Number
4th end melt
My friend 'Mr.Satomi': 8kA-3.3mm-2.0ms ~ 4th end melt.
Turning point
Rotate around turning point
1. 1st+2nd heal fast
2. 3rd increase
3. 4th the end melt.
NONE
SEI
5.0kV
X50
100 μm

2nd content

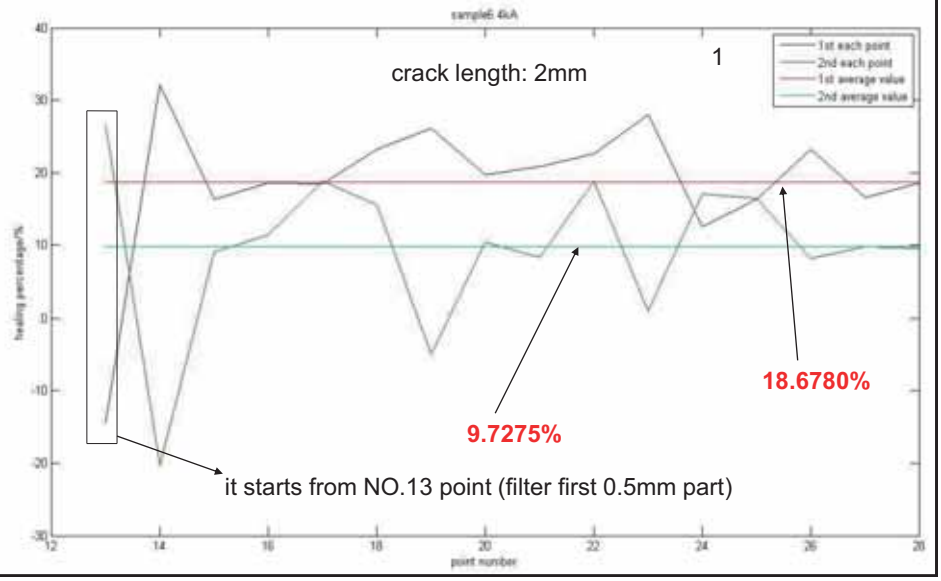
- Healing percentage (healing speed)



- Equation: $h_1 = \frac{y_{bc} - y_1}{y_{bc}} \times 100\%$ $h_2 = \frac{y_1 - y_2}{y_1} \times 100\%$

where h: healing percentage; y:crack width

Healing Percentage



current times	healing percentage/%			
	4kA-2.0mm-2.0ms	4kA-2.5mm-3.0ms	6kA-2.5mm-2.0ms	8kA-2.0mm-2.0ms
1	18.678	20.7336	31.675	15.5266
2	9.7275	4.4349	26.973	9.2983

similar to each other

- Equation: $h_1 = \frac{y_{bc} - y_1}{y_{bc}} \times 100\%$ $h_2 = \frac{y_1 - y_2}{y_1} \times 100\%$

where h: healing percentage; y:crack width

Conclusion3

healing percentage: 6kA>4kA = 8kA

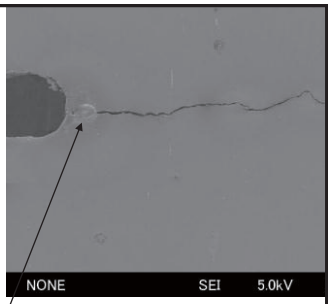
Summary

current /kA	1st heal speed/%	2nd heal speed/%	damgage	limitation
4	18.678	9.7275	small	heal limitation
6	31.675	26.973	serious	not found yet
8	15.5266	9.2983	serious	early melt

Conclusion

- 1. 6kA is the best current condition because of its fast healing speed.
- 2. 4kA has limitation since crack width fails to heal any more after 2nd time.
- 3. 8kA makes specimen melt after 4th time with slow healing speed.

Problems



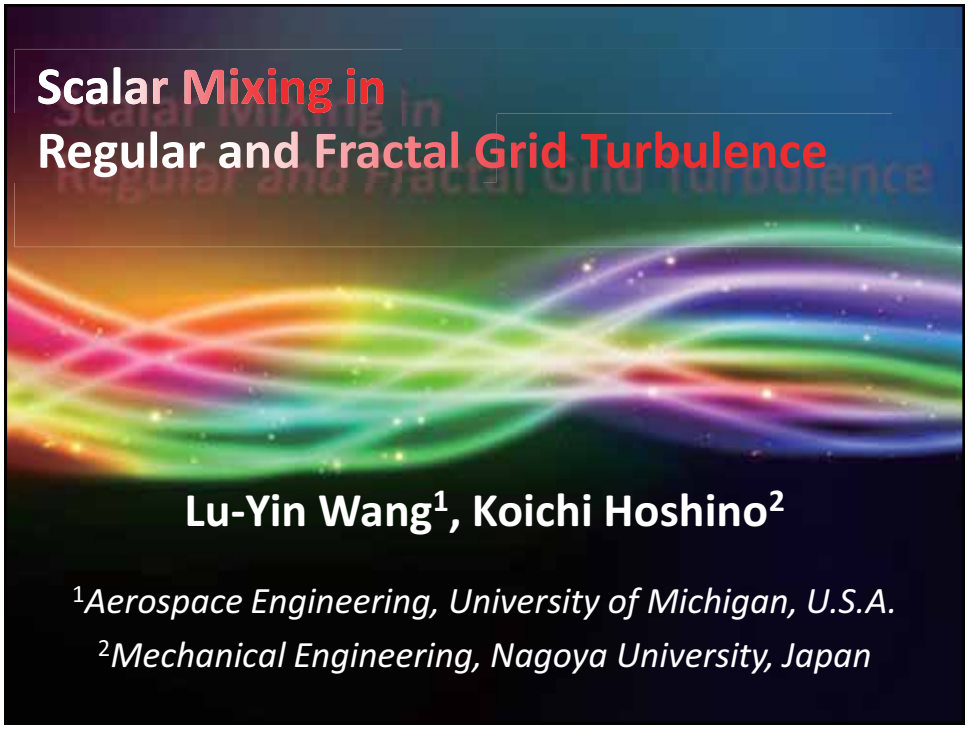
- unstable:
- 6kA: 1st success
  - 2nd serious surface damage
  - 3rd melt after 1st time...!!!

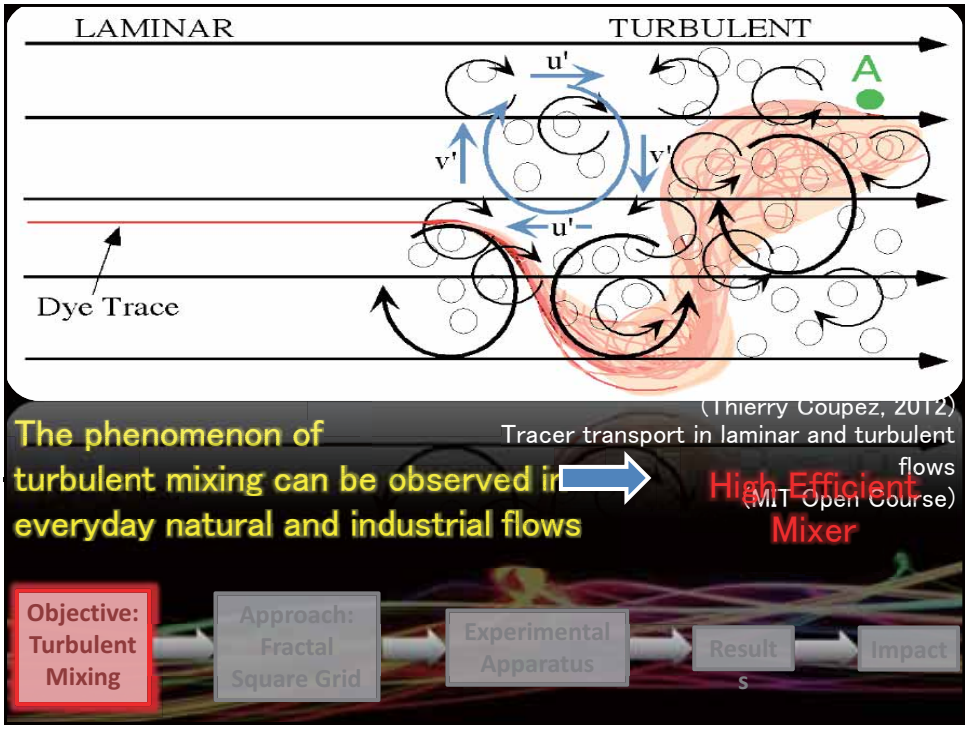
Shame on them...

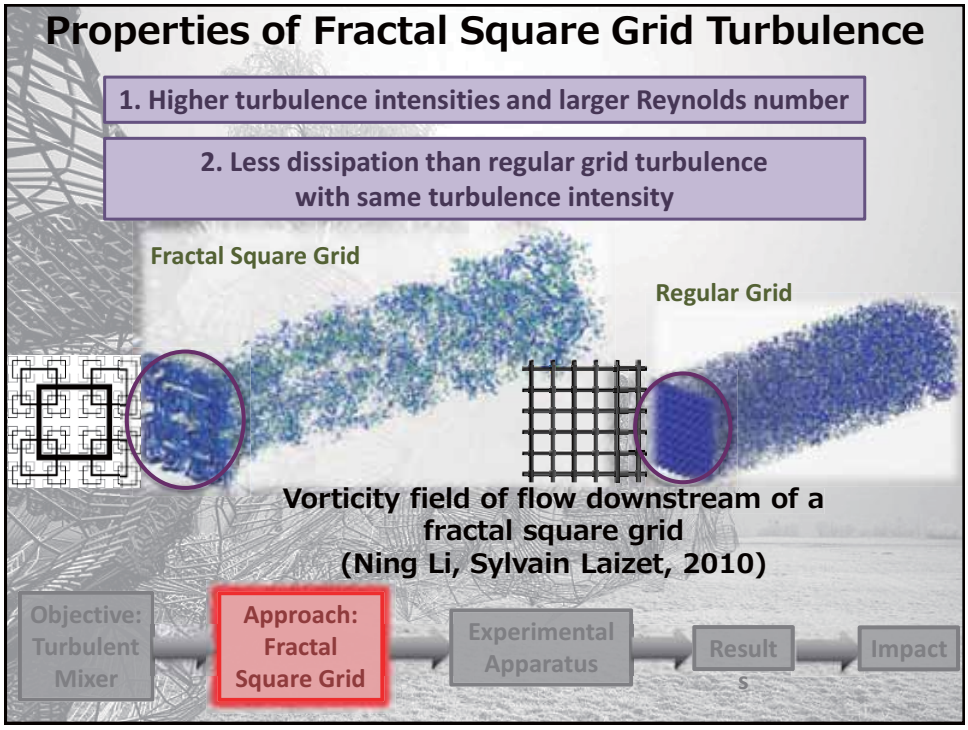
2.5mm
2.0mm
?

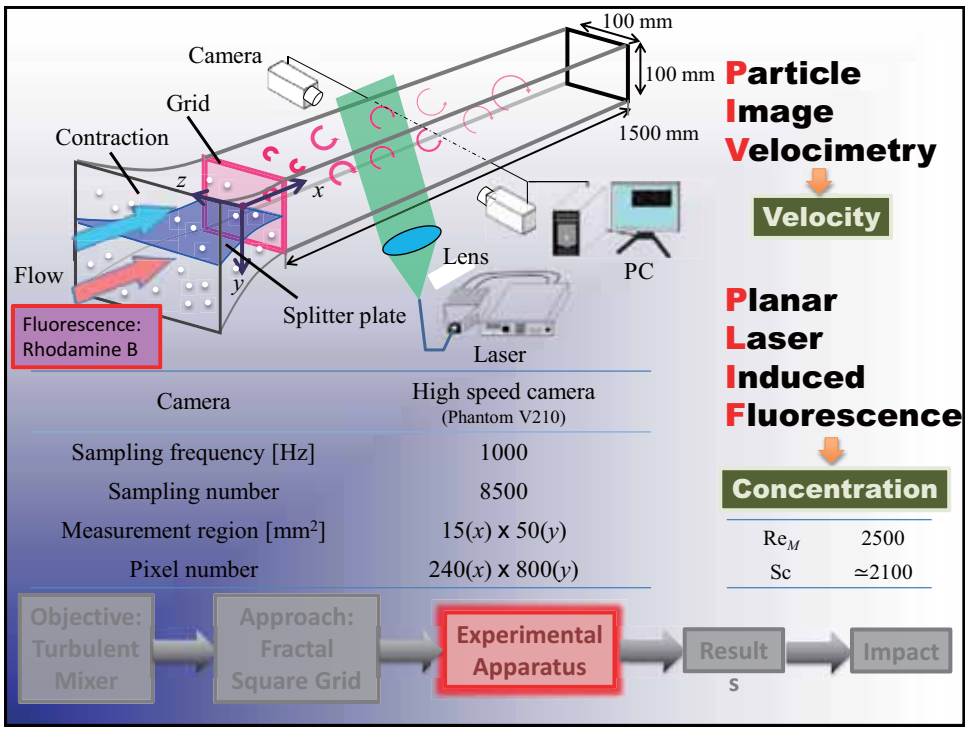
Kishi San がんばってください!!
It's time for u to find something! LOL~~

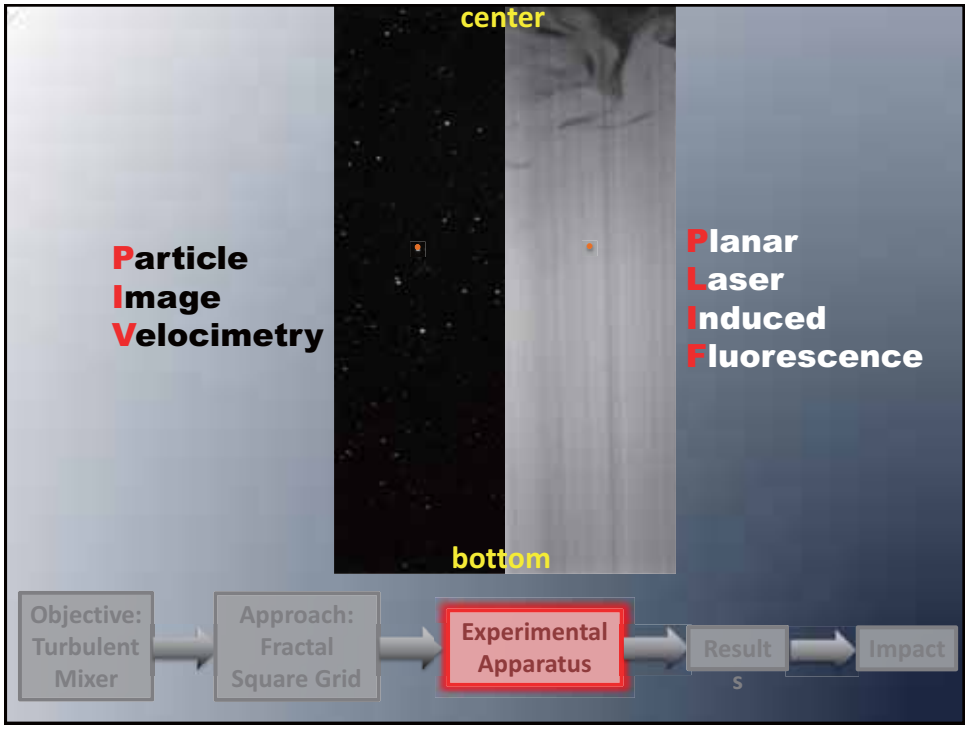
- Thank you very much for your attention!

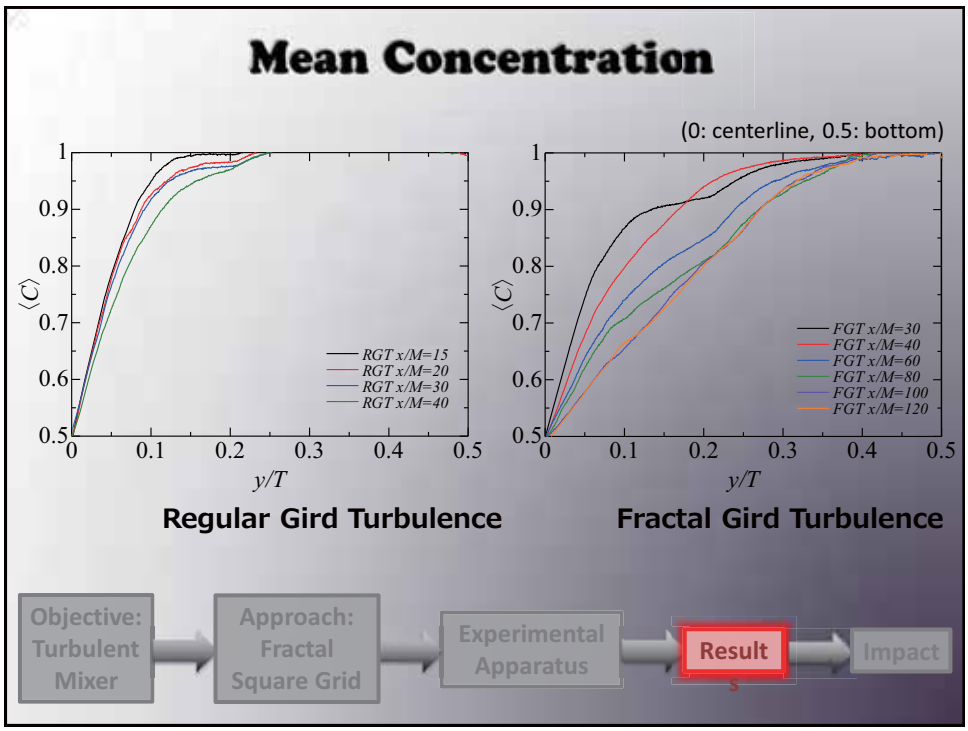

Scalar Mixing in
Regular and Fractal Grid Turbulence
Lu-Yin Wang[1], Koichi Hoshino[2]
[1]Aerospace Engineering, University of Michigan, U.S.A.
[2]Mechanical Engineering, Nagoya University, Japan

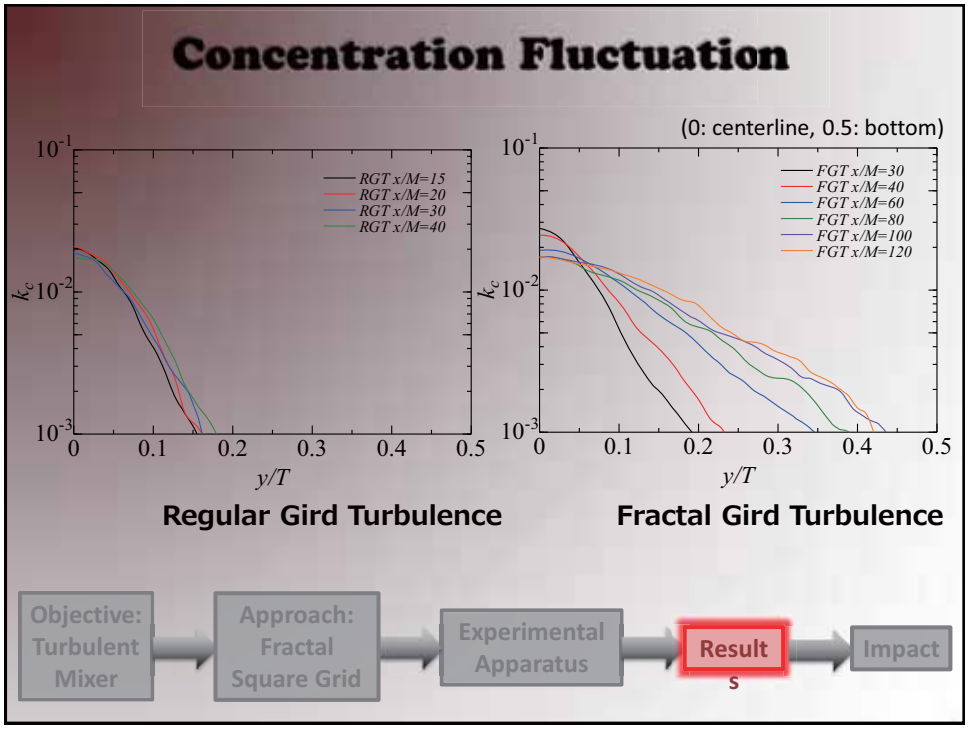

LAMINAR
TURBULENT
u'
v'
v'
u'
A
Dye Trace
(Thierry Coupez, 2012)
Tracer transport in laminar and turbulent flows
(MIT Open Course)
The phenomenon of turbulent mixing can be observed in everyday natural and industrial flows
High Efficient Mixer
Objective: Turbulent Mixing
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact

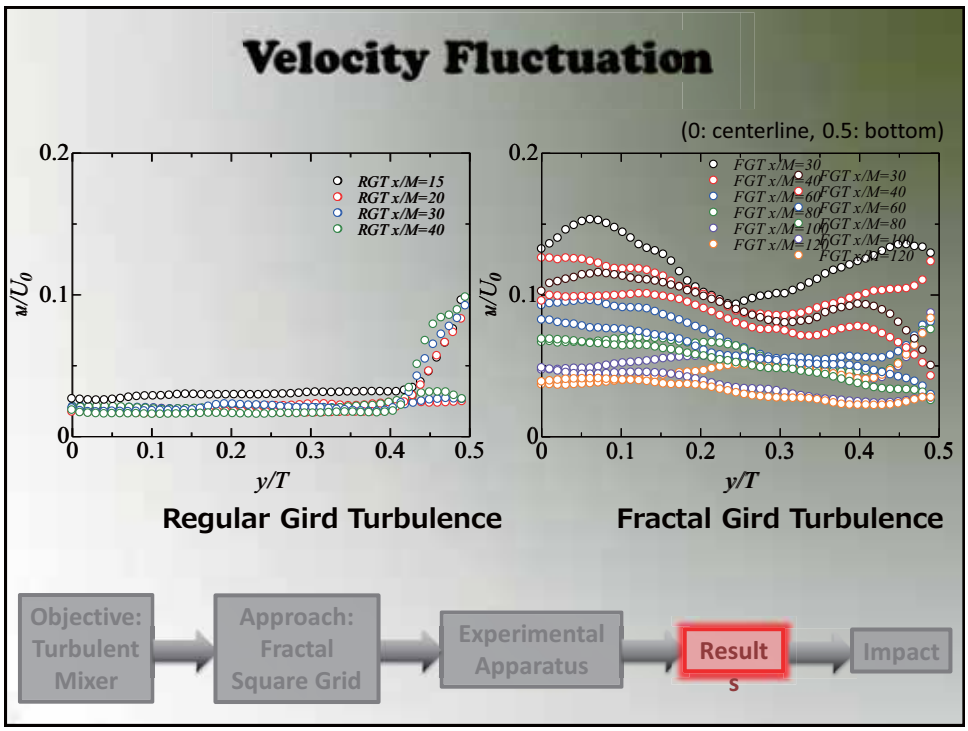

Properties of Fractal Square Grid Turbulence
1. Higher turbulence intensities and larger Reynolds number
2. Less dissipation than regular grid turbulence with same turbulence intensity
Fractal Square Grid
Regular Grid
Vorticity field of flow downstream of a fractal square grid
(Ning Li, Sylvain Laizet, 2010)
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact

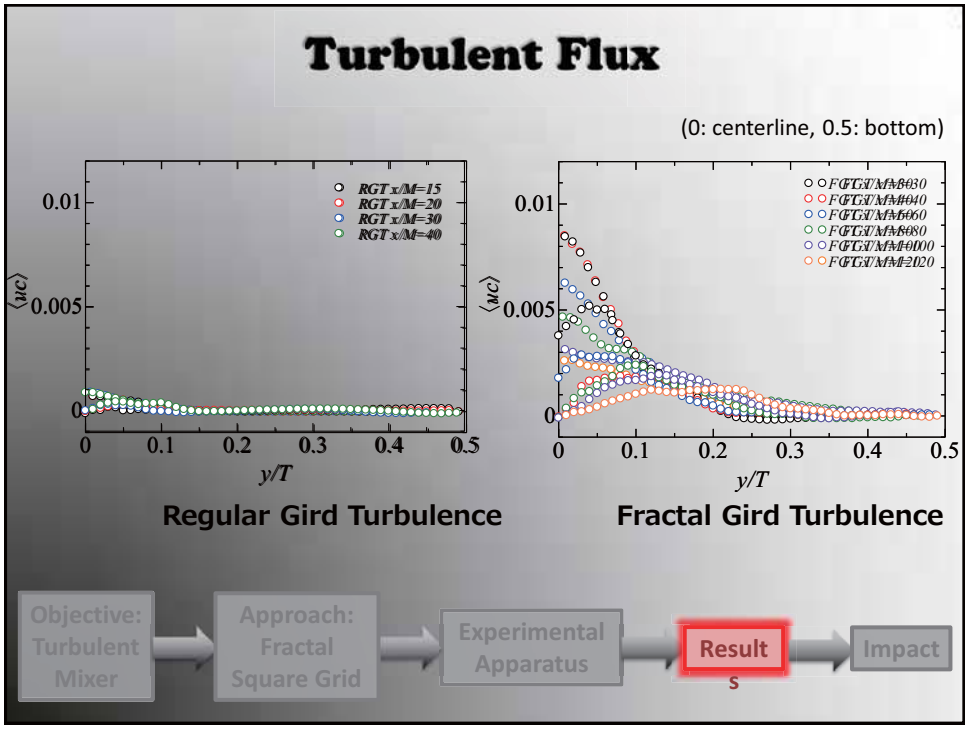

100 mm
100 mm
1500 mm
Camera
Grid
Contraction
z
x
y
Flow
Fluorescence: Rhodamine B
Splitter plate
Lens
Laser
PC
Particle Image Velocimetry
Velocity
Planar Laser Induced Fluorescence
Concentration
Camera
High speed camera (Phantom V210)
Sampling frequency [Hz]
1000
Sampling number
8500
Measurement region [mm²]
15(x) x 50(y)
Pixel number
240(x) x 800(y)
Re_M
2500
Sc
≃2100
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact

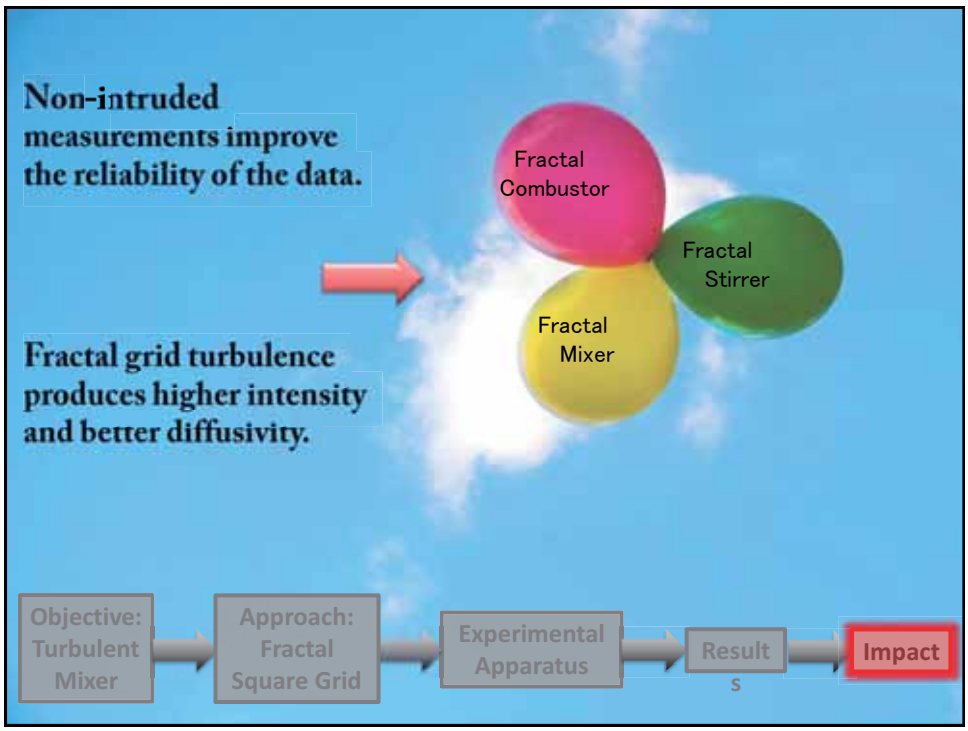

center
bottom
Particle
Image
Velocimetry
Planar
Laser
Induced
Fluorescence
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact

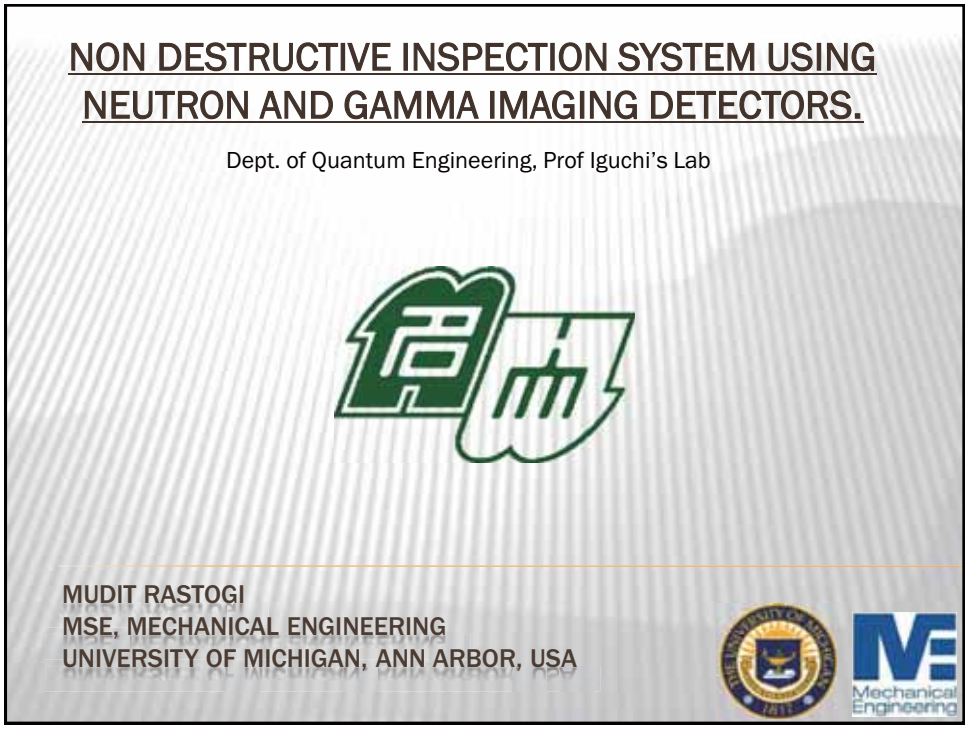

Mean Concentration
(0: centerline, 0.5: bottom)
⟨C⟩
y/T
RGT x/M=15
RGT x/M=20
RGT x/M=30
RGT x/M=40
FGT x/M=30
FGT x/M=40
FGT x/M=60
FGT x/M=80
FGT x/M=100
FGT x/M=120
Regular Gird Turbulence
Fractal Gird Turbulence
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact

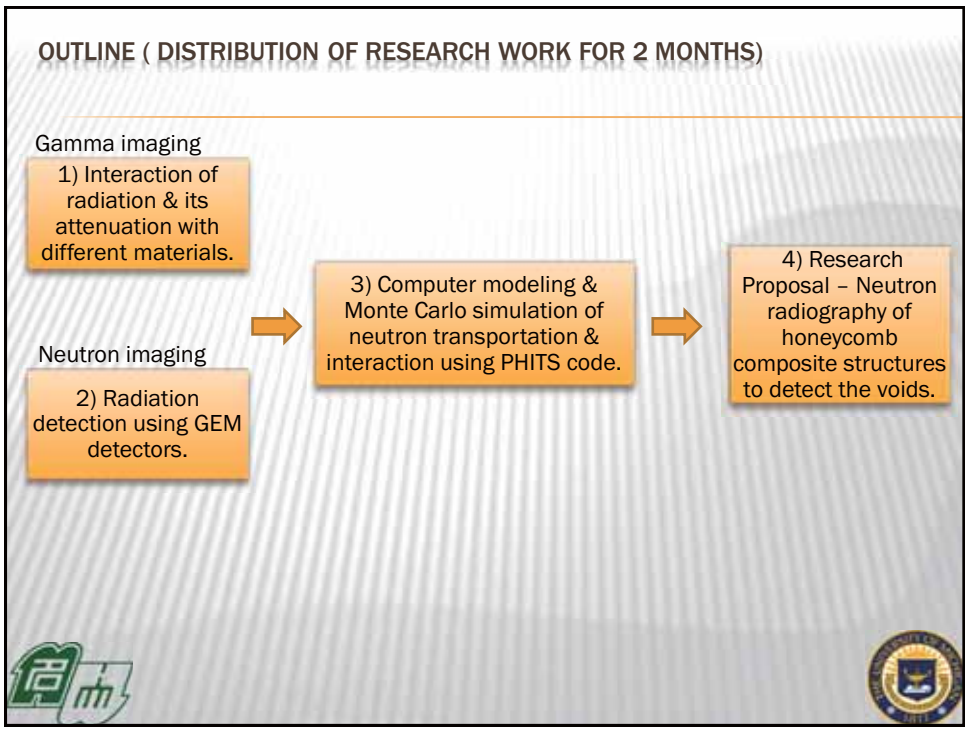

Concentration Fluctuation
(0: centerline, 0.5: bottom)
RGT x/M=15
RGT x/M=20
RGT x/M=30
RGT x/M=40
FGT x/M=30
FGT x/M=40
FGT x/M=60
FGT x/M=80
FGT x/M=100
FGT x/M=120
k_c
y/T
Regular Gird Turbulence
Fractal Gird Turbulence
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact


Velocity Fluctuation
(0: centerline, 0.5: bottom)
RGT x/M=15
RGT x/M=20
RGT x/M=30
RGT x/M=40
FGT x/M=30
FGT x/M=40
FGT x/M=60
FGT x/M=80
FGT x/M=100
FGT x/M=120
u/U_0
y/T
Regular Gird Turbulence
Fractal Gird Turbulence
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact


Turbulent Flux
(0: centerline, 0.5: bottom)
RGT x/M=15
RGT x/M=20
RGT x/M=30
RGT x/M=40
0.01
0.005
0
⟨uc⟩
0 0.1 0.2 0.3 0.4 0.5
y/T
Regular Gird Turbulence
Fractal Gird Turbulence
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact


Non-intruded measurements improve the reliability of the data.
Fractal grid turbulence produces higher intensity and better diffusivity.
Fractal Combustor
Fractal Stirrer
Fractal Mixer
Objective: Turbulent Mixer
Approach: Fractal Square Grid
Experimental Apparatus
Results
Impact


NON DESTRUCTIVE INSPECTION SYSTEM USING NEUTRON AND GAMMA IMAGING DETECTORS.
Dept. of Quantum Engineering, Prof Iguchi's Lab
MUDIT RASTOGI
MSE, MECHANICAL ENGINEERING
UNIVERSITY OF MICHIGAN, ANN ARBOR, USA
Mechanical Engineering


OUTLINE (DISTRIBUTION OF RESEARCH WORK FOR 2 MONTHS)
Gamma imaging
1) Interaction of radiation & its attenuation with different materials.
Neutron imaging
2) Radiation detection using GEM detectors.
3) Computer modeling & Monte Carlo simulation of neutron transportation & interaction using PHITS code.
4) Research Proposal – Neutron radiography of honeycomb composite structures to detect the voids.

1) INTERACTION OF GAMMA RADIATION WITH MATTER USING GE DETECTORS

•The effect of interactions of gamma rays from three different sources namely Co-60, Am-241 and Cs-137 with matter is studied.

•We used Copper, Iron, Lead and Aluminum metals as the matter.

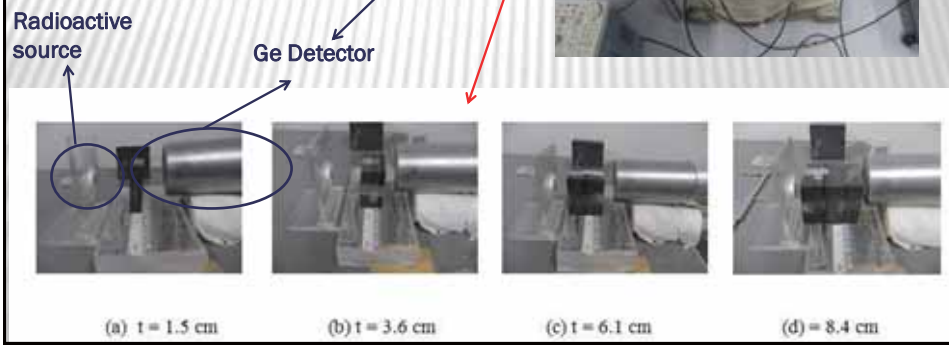
•.The thickness of the metals is increased and the rate of attenuation of radiation is studied using a high purity Ge detector

•We learnt the three most important photon interactions: Photoelectric effect, Compton Scattering and Pair Production

EXPERIMENT

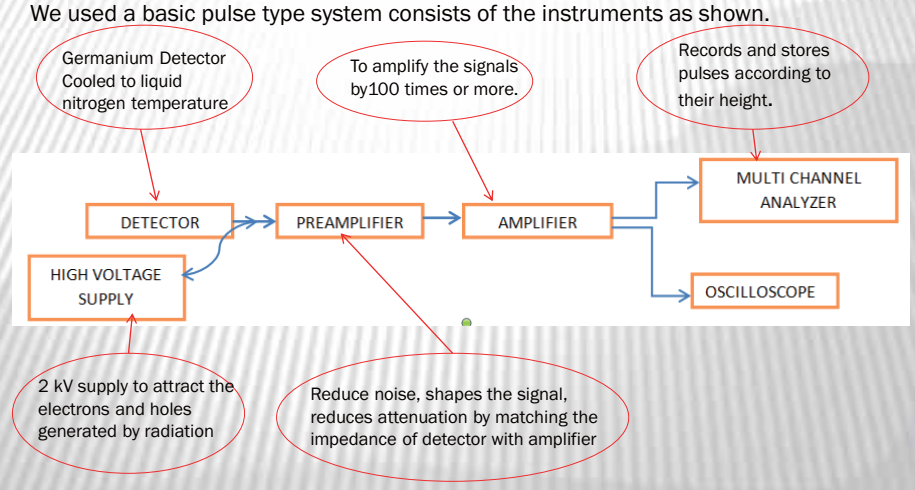
•We used three radioactive sources Co-60, Cs-137 and Am-241 with different gamma ray energies of 1174.97,1334.23, 661.657 and 59.504 keV respectively.

•For all the materials we increased thickness values as 1.6, 3.4, 6.1 and 8.4 cm and noted the radiation attenuation



EXPERIMENT

We used a basic pulse type system consists of the instruments as shown.

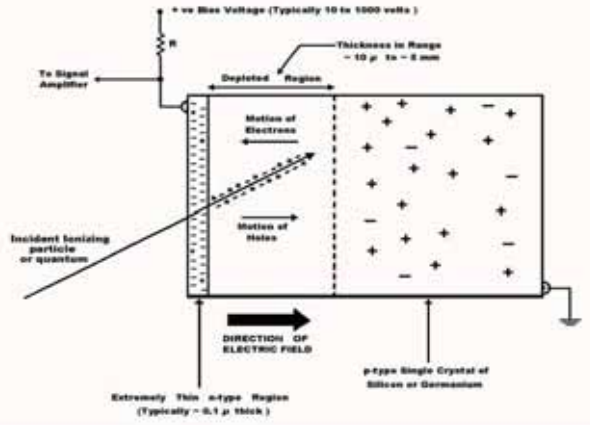


GE DETECTOR

•Ionizing radiation produces free electrons and holes which are proportional to the energy transmitted by the radiation to the semiconductor.

•As a result, a number of electrons are transferred from the valence band to the conduction band, and an equal number of holes are created in the valence band.

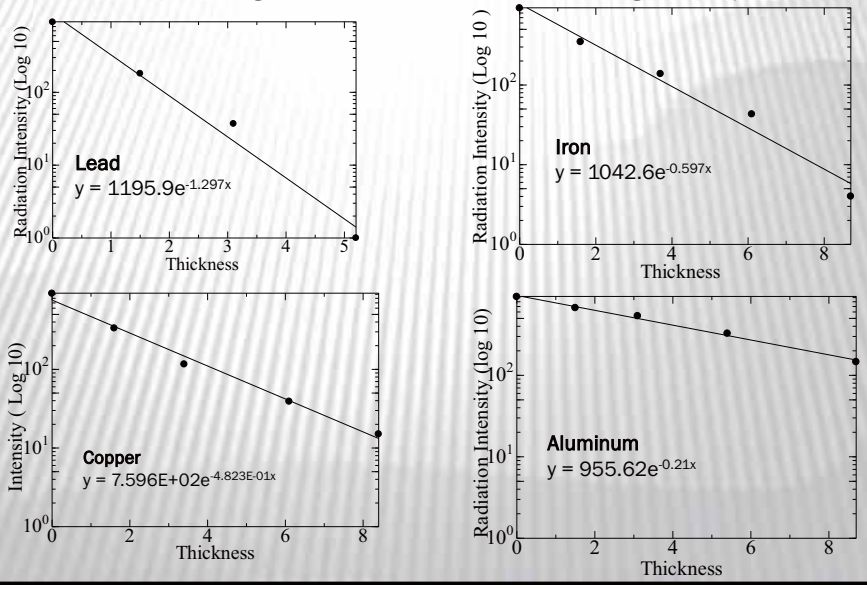
•Under the influence of an electric field, electrons and holes travel to the electrodes, where they result in a pulse that can be measured in an outer circuit, as described by the Shockley- Ramo Theorem



• Measuring the number of electron-hole pairs allows the energy of the incident radiation to be found

RESULTS

For all the materials we got an exponential attenuation of the gamma rays.



RESULTS

The intensity of transmitted radiation is then defined in terms of incident radiation as

$$I = I_o e^{-\mu t}.$$

Where μ = linear attenuation coefficient.
t = thickness of material.

Linear attenuation coefficient varies with the density of the absorber, even though the material of the absorber is the same. Therefore we define a new term as,

$$\text{Mass attenuation coefficient} = \mu / \rho,$$

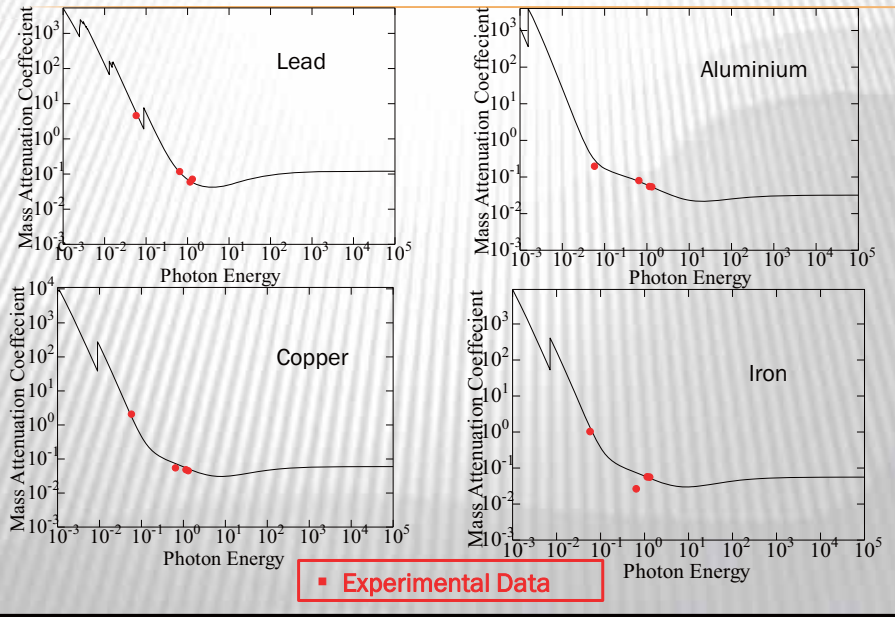
where ρ = mass density.

This value is proportional to the nuclear cross section and hence the radiation absorption characteristic.

RESULTS (MASS ATTENUATION COEFFICIENT OF METALS)

Materials		Lead		Copper		Iron		Aluminium	
Atomic No.		82		29		26		13	
	Exp.	0.0576	0.0526	0.0472	0.0439	0.0554	0.0544	0.0537	0.052593
Co - 60	NIST	0.0696	0.0587	0.0583	0.0526	0.0535	0.0535	0.0227	0.0222
Energy	1174.97 KeV	1334.23K eV							
	Exp.	0.1143		0.0533		0.0758		0.0777	
Cs-137	NIST	0.1248		0.0762		0.7704		0.078	
Energy	661.657 KeV								
	Exp.	4.472		2.021		1.004318		0.191851852	
Am-241	NIST	5.02		1.59		1.205		0.277	
Energy	59.504 KeV								

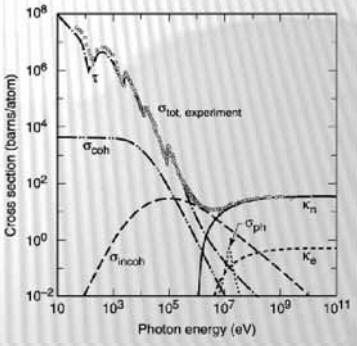
COMPARISON OF EXPERIMENTAL RESULTS WITH NIST (NATIONAL INSTITUTE OF SCIENCE & TECHNOLOGY) DATABASE.



RESULTS

•For the same source of gamma ray radiation, materials with higher atomic no. show greater value of mass attenuation coefficient. This signifies a greater nuclear cross section because of increased photoelectric, Compton and pair production effect with increase in atomic no and thus better radiation absorption.

•For different radiation source with their respective gamma ray energies, the nuclear cross section decreases as we increase the energy. This is due to the sharp decrease in Photoelectric and Compton Effect as compared to the increase in Pair Production. As a result the combined effect is of decrease as shown below.



2) EXPERIMENT USING GEM BASED IMAGING SYSTEM WITH RADIOACTIVE ISOTOPE METHOD.

OBJECTIVES:

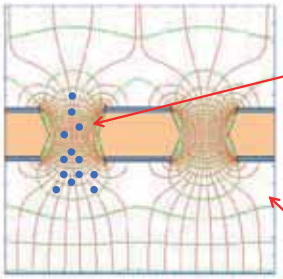
•Working Principle of GEM (Gas Electron Multiplier) Detectors.

•Experiment using Cf -252 as neutron source and Co-60 as gamma source.

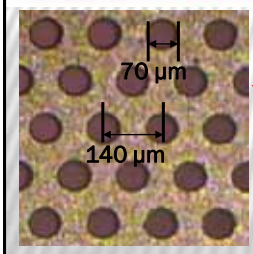
•Obtain a 2-D neutron image.

•Obtain a pulse height histogram.

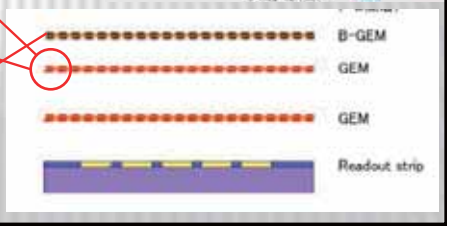
WORKING



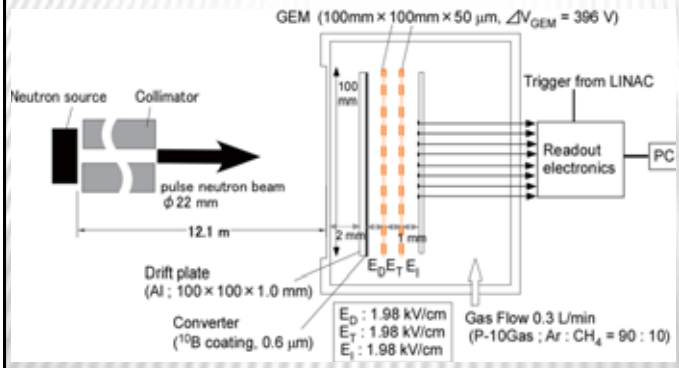
GEM is able to collect the electrons released by ionizing radiation, guiding them to a region with a large electric field, and thereby initiating an electron avalanche. The avalanche is able to produce enough electrons to create a current or charge large enough to be detected by electronics.

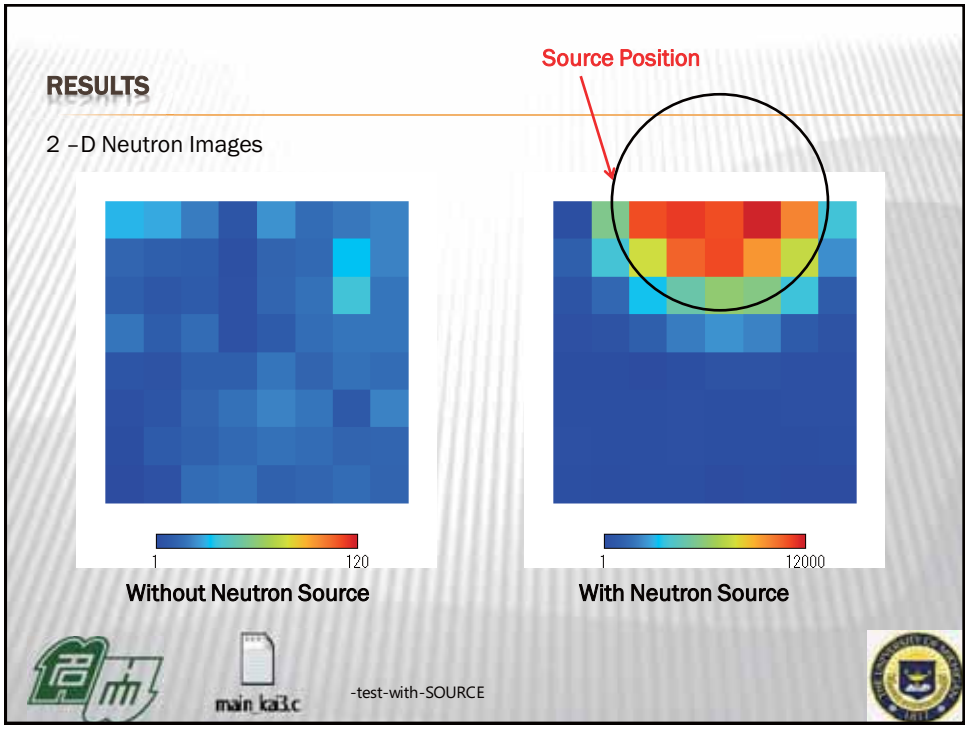


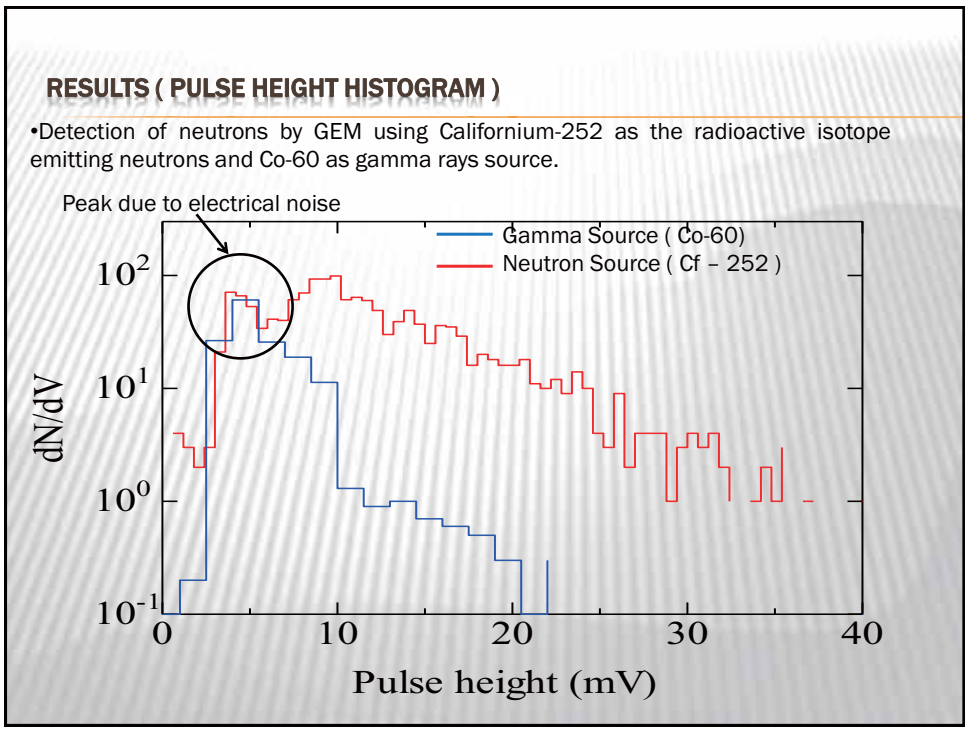
^{10}B converter sheets are used to enable to change the neutrons to change into charged particles using ^{10}B(n,α)^{7}Li reaction



EXPERIMENT

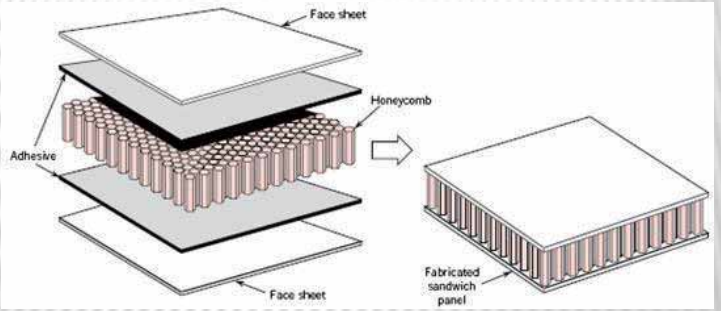



RESULTS
2 –D Neutron Images
Source Position
1
120
1
12000
Without Neutron Source
With Neutron Source
main_ka3.c
-test-with-SOURCE


RESULTS (PULSE HEIGHT HISTOGRAM)
•Detection of neutrons by GEM using Californium-252 as the radioactive isotope emitting neutrons and Co-60 as gamma rays source.
Peak due to electrical noise
Gamma Source (Co-60)
Neutron Source (Cf – 252)
dN/dV
10^2
10^1
10^0
10^{-1}
0
10
20
30
40
Pulse height (mV)

RESEARCH PROPOSAL

To locate the voids in the adhesive layer of the honeycomb structure using Neutron Radiography and GEM detector.

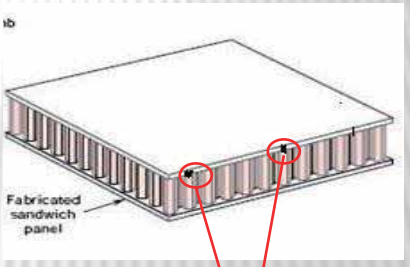


Honeycomb structures are manufactured using an **aluminum core** with **epoxy resins**. The **carbon reinforced sheets** are bonded to the core using adhesive creating the fillet bond.

PROBLEM

When water infiltrates honeycomb composite panels, it moves throughout the structure in a very random manner, which causes degradation of the adhesive bond and thus affecting the structural integrity of the component.

Ultra sonic scan of honeycomb composite structure showing water.



Voids in adhesive layer of honeycomb structure filled with moisture.

PHITS CALCULATION

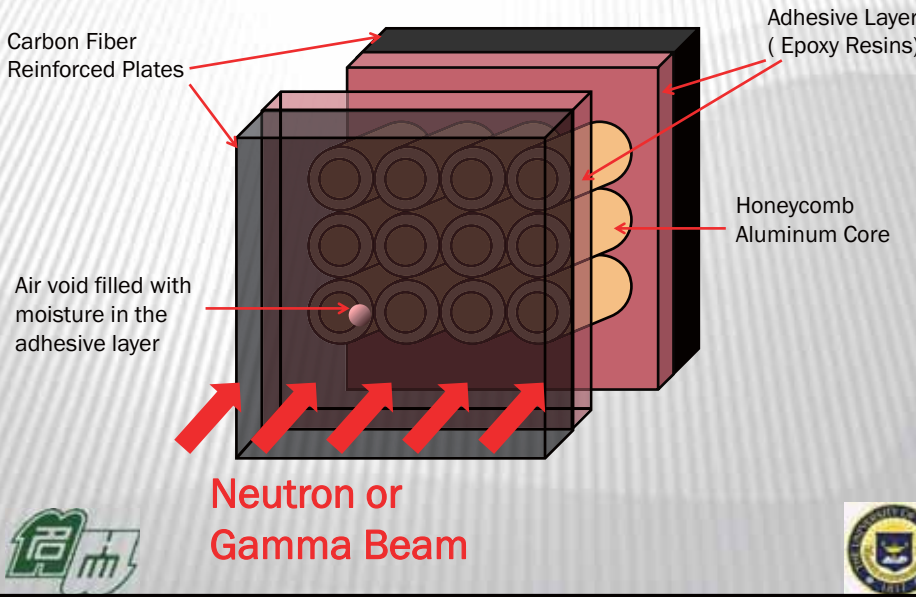
•The adhesive epoxy resin contains different materials like filler, hardener, curator, resins in different proportions.

•As a result it has no fixed density of itself. But when added with some external material then it ranges from 2g/cc to 11g/cc.

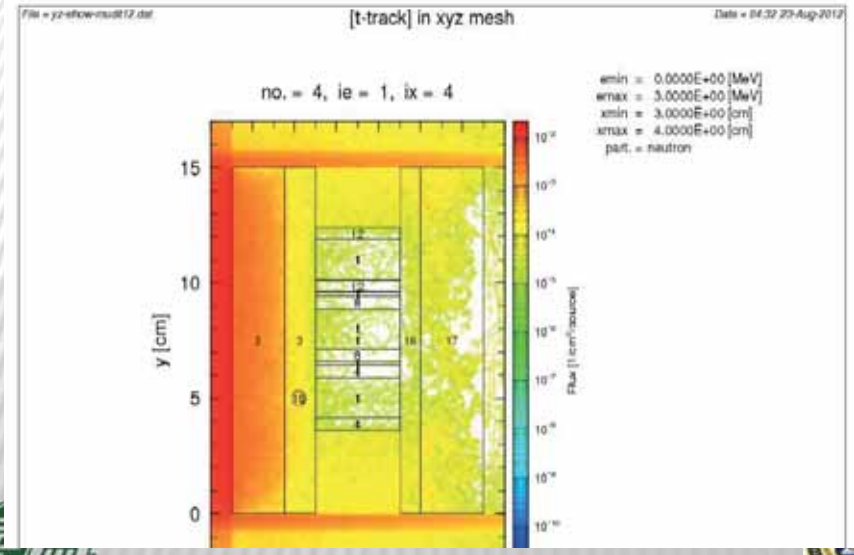
• Made a honeycomb structure model and studied the neutron transportation and interaction for different densities of adhesive layer and different photon energy on PHITS.

•**PHITS** is a general purpose Monte Carlo particle transport code written in FORTRAN. PHITS can deal with the transport of **all particles** (*nucleons, nuclei, mesons, photons, and electrons*) over wide energy ranges, using several nuclear reaction models and nuclear data libraries.

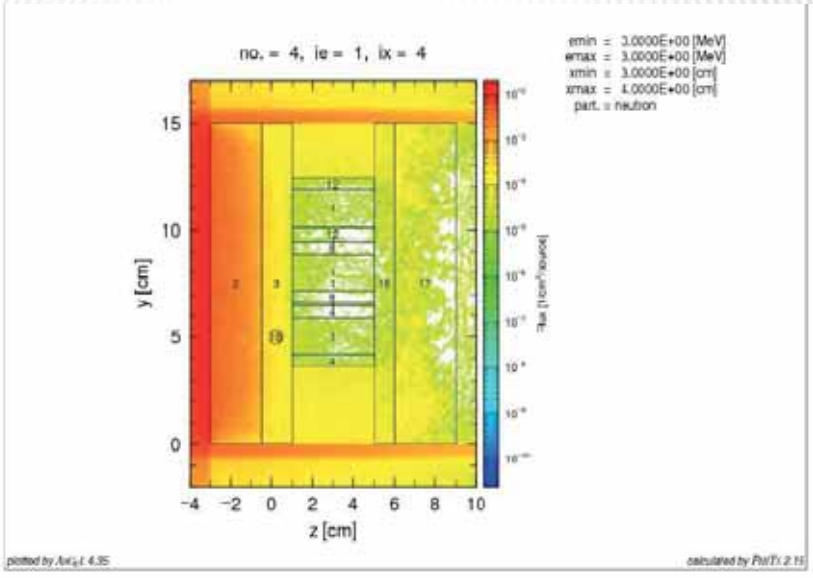
CALCULATION MODEL ON PHITS CODE



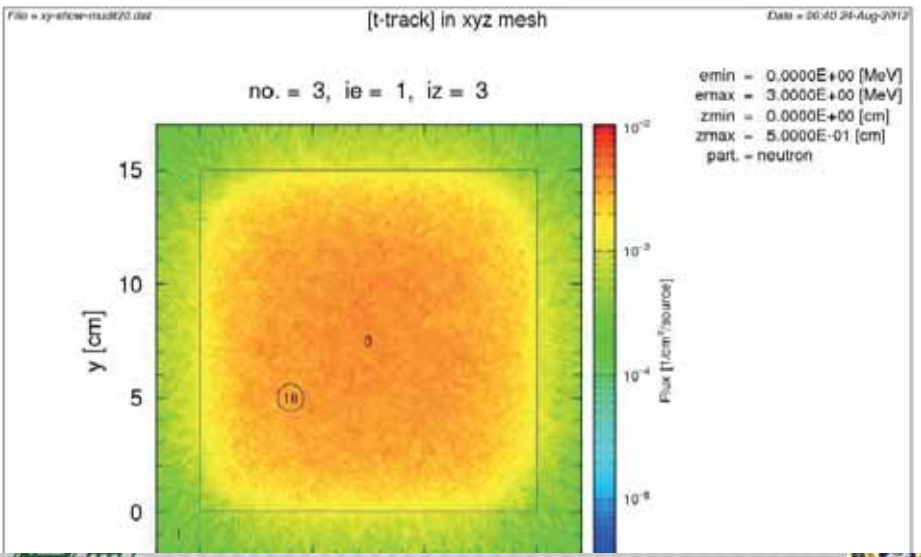
PHITS SIMULATION
1) ENERGY = 1 EV, NEUTRON INTENSITY = 1500 X 1500 , DENSITY = 2.78 G/CC



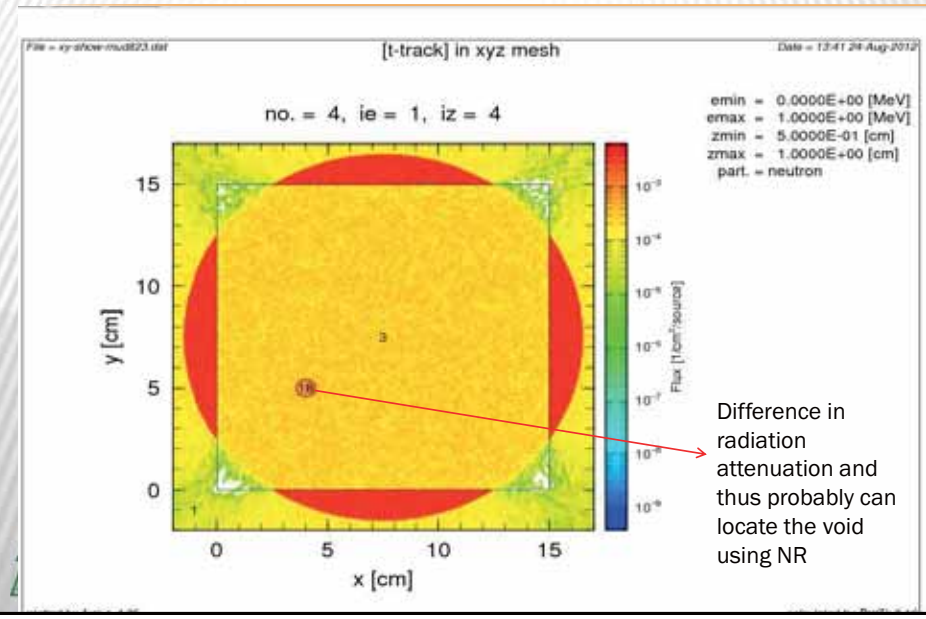
PHITS SIMULATION
1) ENERGY = 1 EV, NEUTRON INTENSITY = 2000 X 2000 , LAYER DENSITY = 2.78 G /CC



PHITS SIMULATION
1) ENERGY = 50 KEV, LAYER DENSITY = 2.78 G /CC

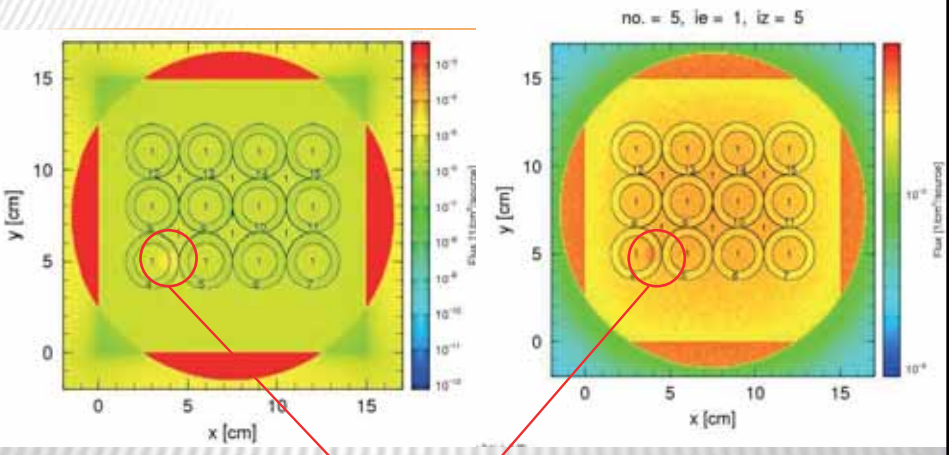


PHITS SIMULATION
1) ENERGY = 50 KEV, LAYER DENSITY = 7 G /CC



Difference in radiation attenuation and thus probably can locate the void using NR

COMPARISON : NEUTRON AND GAMMA INTERACTION USING PHITS



WITH NEUTRON SOURCE

WITH GAMMA SOURCE

Neutron Interaction gives a better contrast and increased radiation attenuation than Gamma source.

CONCLUSION

- It is possible to locate the voids filled with moisture in the honeycomb sandwich structure using Neutron and Gamma Radiography.
- Neutron Interaction gives a much more clear and sharp image than Gamma Interaction, and hence Neutron Radiography is the preferred option.
- The results, clarity and spatial resolution of the image largely depends on the mass density and thickness of the adhesive layer.
- Future work includes lab experiment to verify the results.

LEARNINGS

•Interaction of radiation with matter, mainly Photoelectric effect, Compton Scattering and Pair Production, Nuclear Cross section and their dependence on atomic no. and Photon Energy.

•Different type of radiation detection techniques, - GEM, Scintillators, PMT, and Semiconductor Detectors (HpGe).

•Monte Carlo simulation and computer modeling of neutron transportation and interaction using PHITS software.

•Different kinds of NDT and their applications.

•Ability to propose a NDT based on radiation detection and most suitable for the application.

ACKNOWLEDGEMENTS

•These experiments are done at the Radiation Lab, Department of Quantum Engineering, Nagoya University , Japan under the kind guidance of Prof T. Iguchi and Prof H . Tomita.

•Thanks to all the lab mates for their support and help.

THANKS

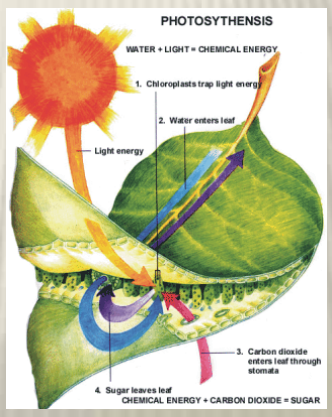
DYE SENSITIZED SOLAR CELLS AND PHOTOVOLTAIC-THERMOELECTRIC HYBRID DEVICE

Sajeev Gulyani
MSE Aerospace Engineering
University of Michigan, Ann Arbor

Shinichirou Yamazaki
M.Sc. Applied Chemistry
Nagoya University, Nagoya

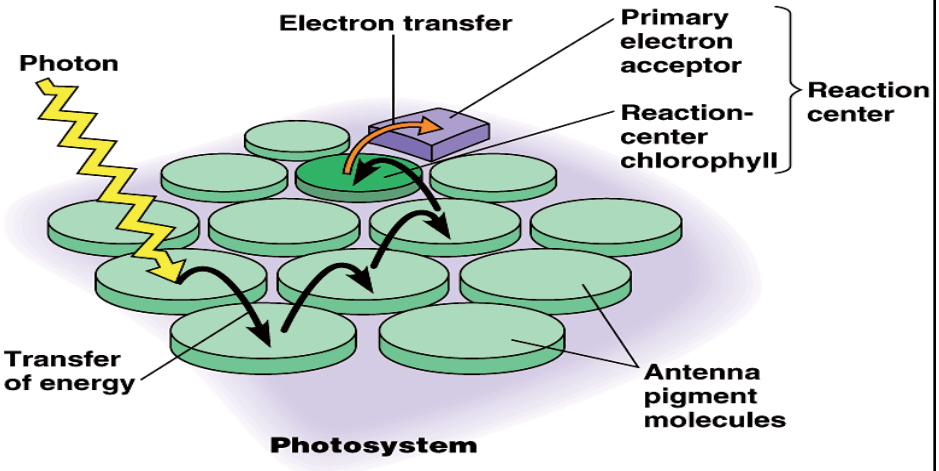
RESEARCH BACKGROUND

- Leaves of plants are tiny factories, not very efficient, but very effective over a wide range of sunlight conditions.



(Picture downloaded from the web)

RESEARCH BACKGROUND



(Picture downloaded from the web)

Sajeev Gulyani
Shinichiro Yamazaki

RESEARCH BACKGROUND

- Since 1970s, attempts have been made to create a better solar cell based on this principle.
- Covering crystals of semiconductor Titanium Dioxide with chlorophyll- low efficiency!
- Nanotechnology to the rescue!

Sajeev Gulyani
Shinichiro Yamazaki

DSC- NEXTGEN SOLAR CELLS

1st generation

Crystalline silicon solar cells

2nd generation

Silicon based thin film solar cells

3rd generation

Dye-Sensitized Solar Cells

Cost of Production

1st generation > 2nd generation >> 3rd generation

(Pictures downloaded from the web)

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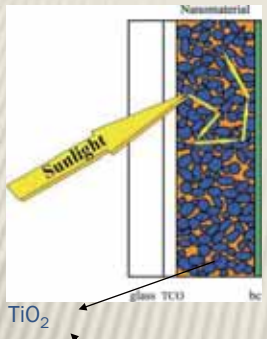
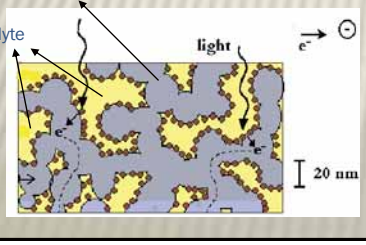
Shinichiro Yamazaki

DSC COMPONENTS



TiO_2



1. Granular TiO_2 forms a nano-porous structure (mesoscopic conductor)
2. A dye, which is a light sensitive pigment is spread on the surface of the semiconductor TiO_2.
3. A redox couple (I^-/I_3^-), located in the space between the dye and the cathode.
4. A solvent for the redox couple.

(Pictures downloaded from web)

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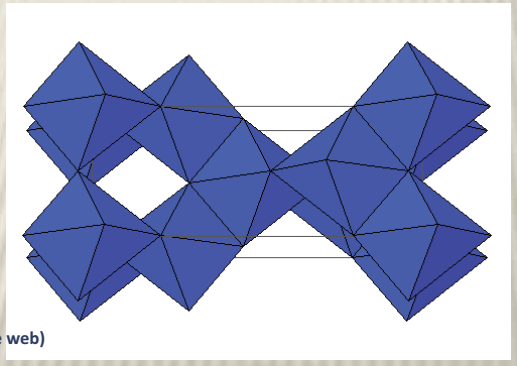
Shinichiro Yamazaki

TITANIA

- Anatase phase, mesostructured Titania crystals



(Picture downloaded from the web)

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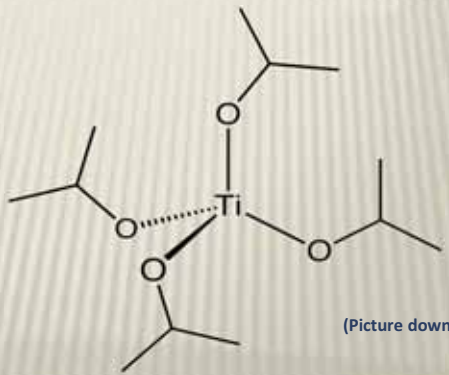
Shinichiro Yamazaki

TITANIUM ISOPROPOXIDE

$Ti\{OCH(CH_3)_2\}_4 + 2\ H_2O \rightarrow TiO_2 + 4\ (CH_3)_2CHOH$



(Picture downloaded from the web)

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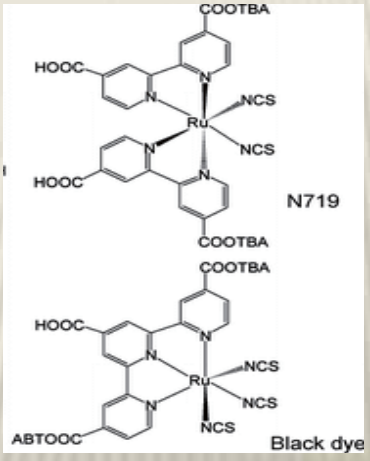
Shinichiro Yamazaki

RUTHENIUM DYES



(Picture downloaded from the web)

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Shinichiro Yamazaki

THE ELECTROLYTE

$$I_3^- + 2e^- \rightarrow 3I^-$$

$$3I^- \rightarrow 2e^- + I_3^-$$

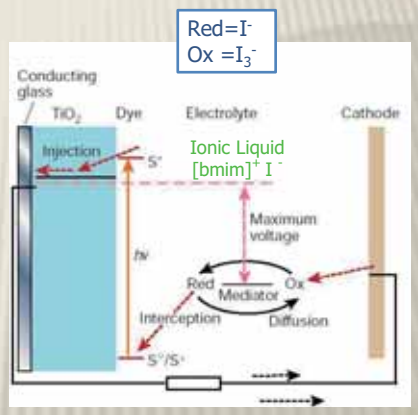
Iodide/Triiodide:

- Absorbs in visible region of spectrum
- Aggressively attacks silver current collectors
- Low redox potential limits open circuit voltage

Sajeev Gulyani
Shinichiro Yamazaki

DSC: OPERATION

1. Dye electrons are excited due to solar energy absorption.
2. Excited electrons are injected into the conduction band of TiO_2.
3. Electron transfer to the counter electrode through the external circuit.
4. $I_3^- + 2e^- \rightarrow 3I^-$: Redox regeneration reaction (oxidation).
5. $3I^- \rightarrow I_3^- + 2e^-$: Dye regeneration reaction (reduction).
6. Potential used for external work:
$$\Delta V_{ext} = E_F - \Delta V_{redox}$$



(Picture downloaded from the web)

Sajeev Gulyani
Shinichiro Yamazaki

TIO2 POROUS LAYER PASTE PREPERATION

5.86g Titanium isopropoxide

1.2g Acetic acid

30ml water

Stir for 1h at room temp

Add 0.4ml nitric acid

Stir for 75 min,80℃

Hydrothermal for 12h 200℃

Centrifugation and Ultrasonic wave

Repeat process with water and ethanol

Pure TiO2 colloid

20 ml TiO2 colloid

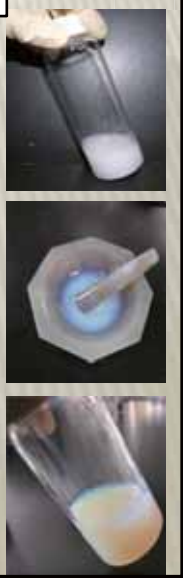
0.8g Ethyl cellulose in 20ml Ethanol

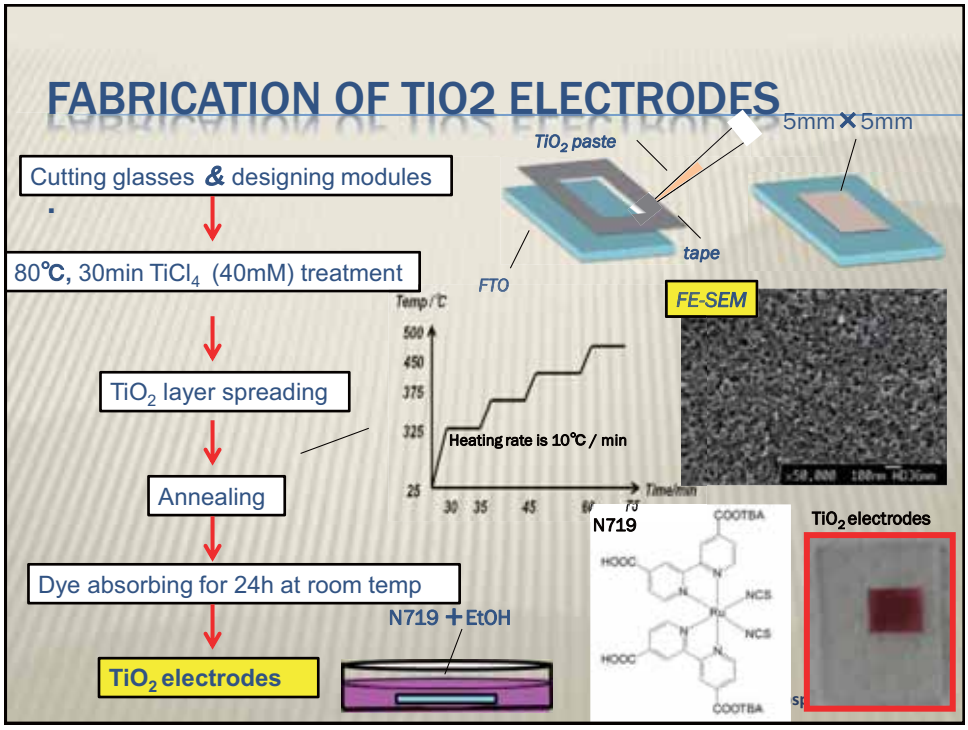
6.49g terpineol

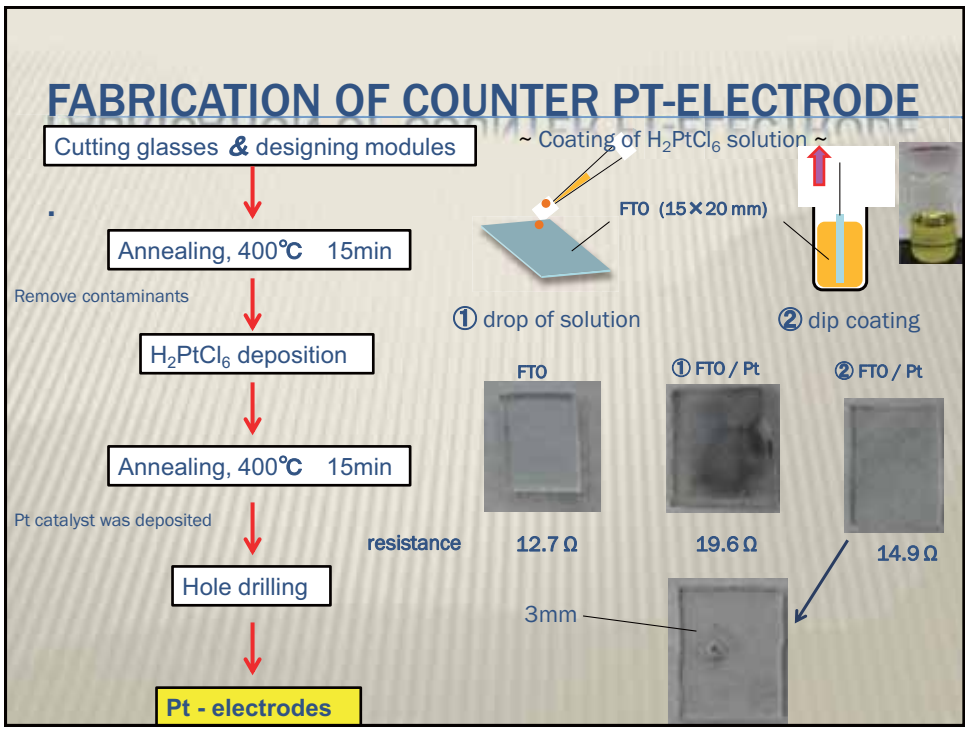
Ultrasonic wave

Mix by mortar for 1h

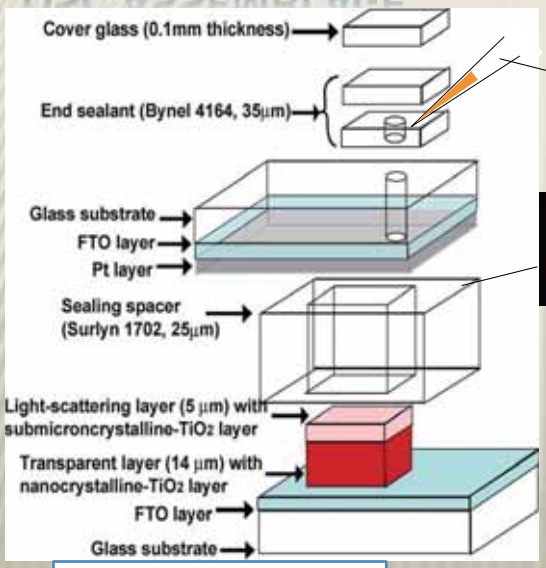
TiO2 porous layer paste




FABRICATION OF TIO2 ELECTRODES
Cutting glasses & designing modules
80℃, 30min $TiCl_4$ (40mM) treatment
TiO_2 layer spreading
Annealing
Dye absorbing for 24h at room temp
TiO_2 electrodes
N719 + EtOH
TiO_2 paste
5mm × 5mm
tape
FTO
FE-SEM
Heating rate is 10℃ / min
Temp/℃
Time/min
N719
TiO_2 electrodes


FABRICATION OF COUNTER PT-ELECTRODE
Cutting glasses & designing modules
Annealing, 400℃ 15min
Remove contaminants
H_2PtCl_6 deposition
Annealing, 400℃ 15min
Pt catalyst was deposited
Hole drilling
Pt - electrodes
~ Coating of H_2PtCl_6 solution ~
FTO (15×20 mm)
① drop of solution
② dip coating
FTO
① FTO / Pt
② FTO / Pt
resistance
12.7 Ω
19.6 Ω
14.9 Ω
3mm

DSC ASSEMBLAGE



Configuration of the DSSC

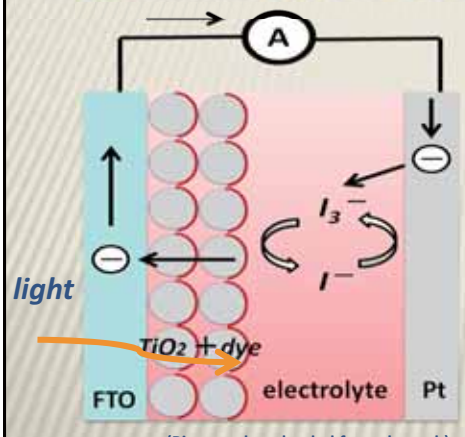
I_2 TBP
Li I ACN

electrolyte

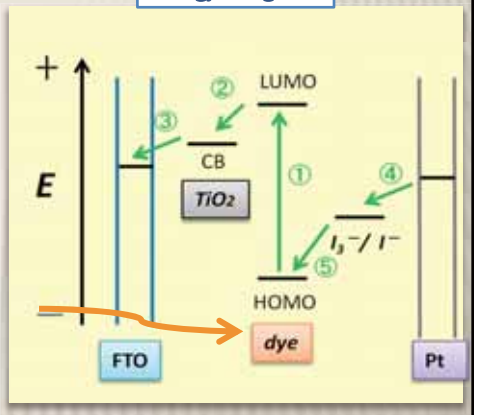
hot – melt gasket
110℃ ,20 min

Seigo Ito, Michael Gratzel et al. Thin Solid Films 516 (2008) 4613-4619

DYE SENSITIZED SOLAR CELLS



Energy Diagram



(Pictures downloaded from the web)

- http://www.youtube.com/watch?v=3KRHJSOgzcw&feature=related

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Shinichiro Yamazaki

DSC REACTIONS

Reaction Equation	Event Description
$E_{hv} + S \rightarrow S^*$	Dye excitation(Photoexcitation)
$S^* \rightarrow E_{hv} + S$	Dye relaxation (Emission)
$S^+ + A^- \rightarrow S + A$	Dye regeneration
$S^* + TiO_2 \rightarrow e^*_{TiO_2} + S^+$	Electron injection
$S^+ + e^*_{TiO_2} \rightarrow TiO_2 + S^*$	Dye recombination
$e_I + A \rightarrow A^-$	Electrolyte reduction

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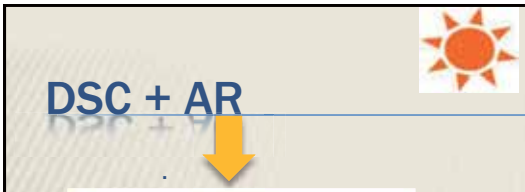
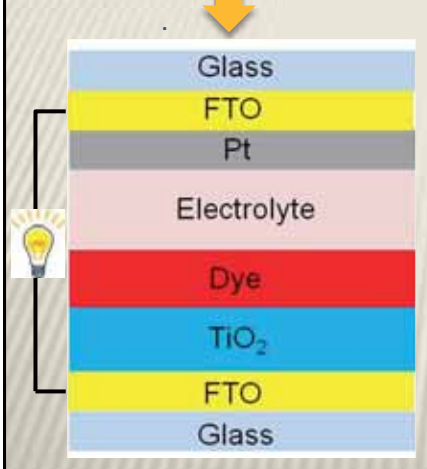
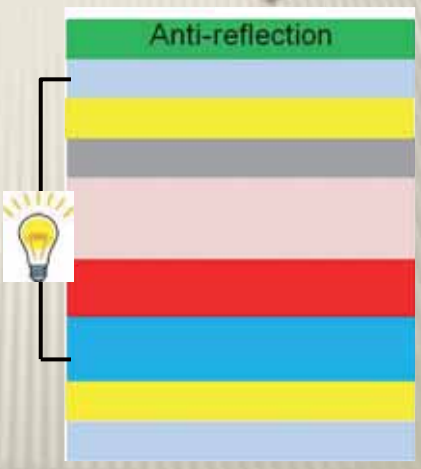
DSC + AR





DSC



DSC + AR

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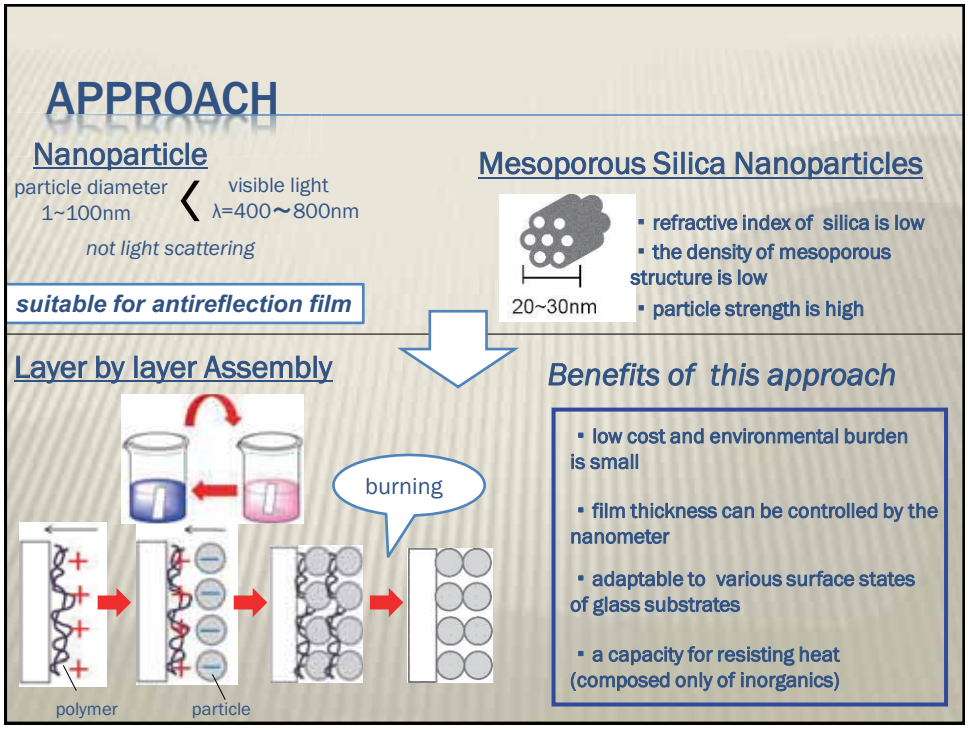
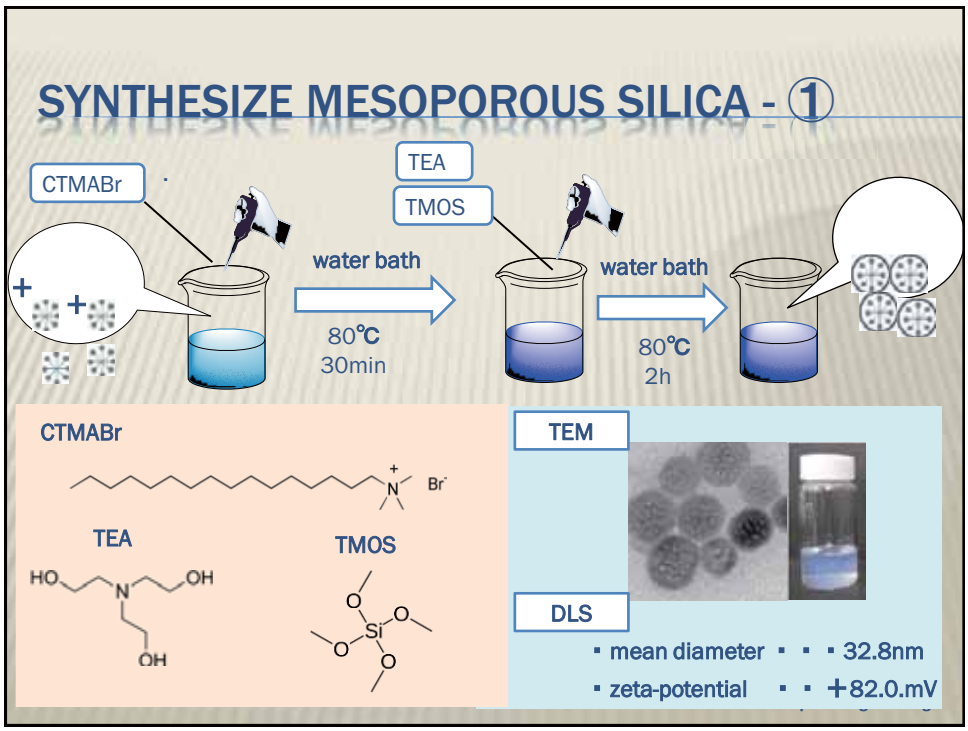
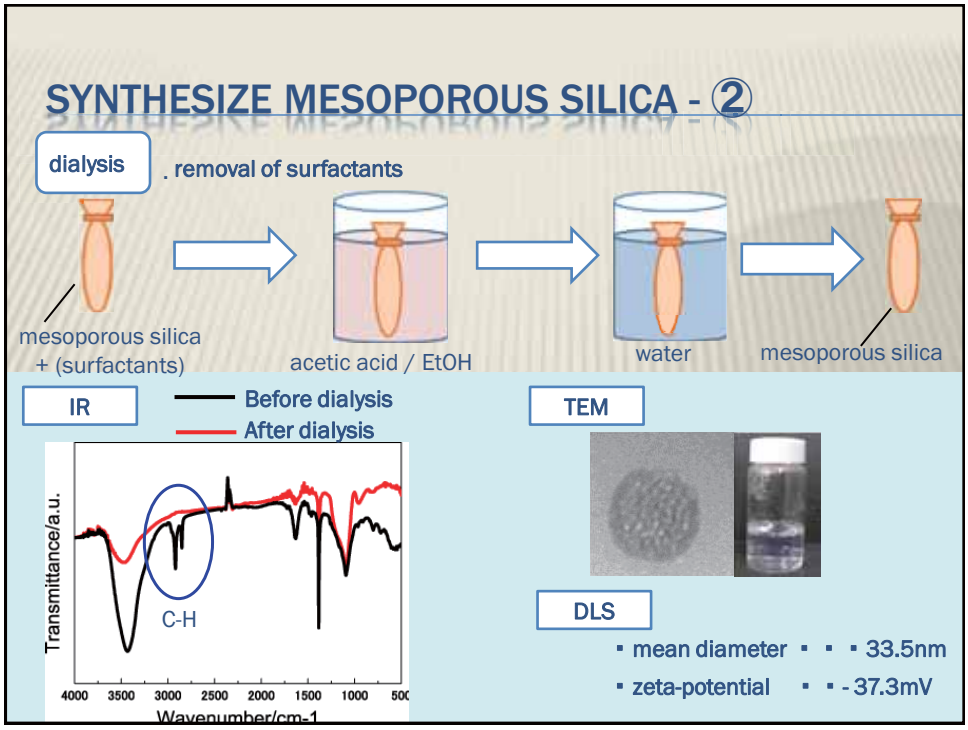
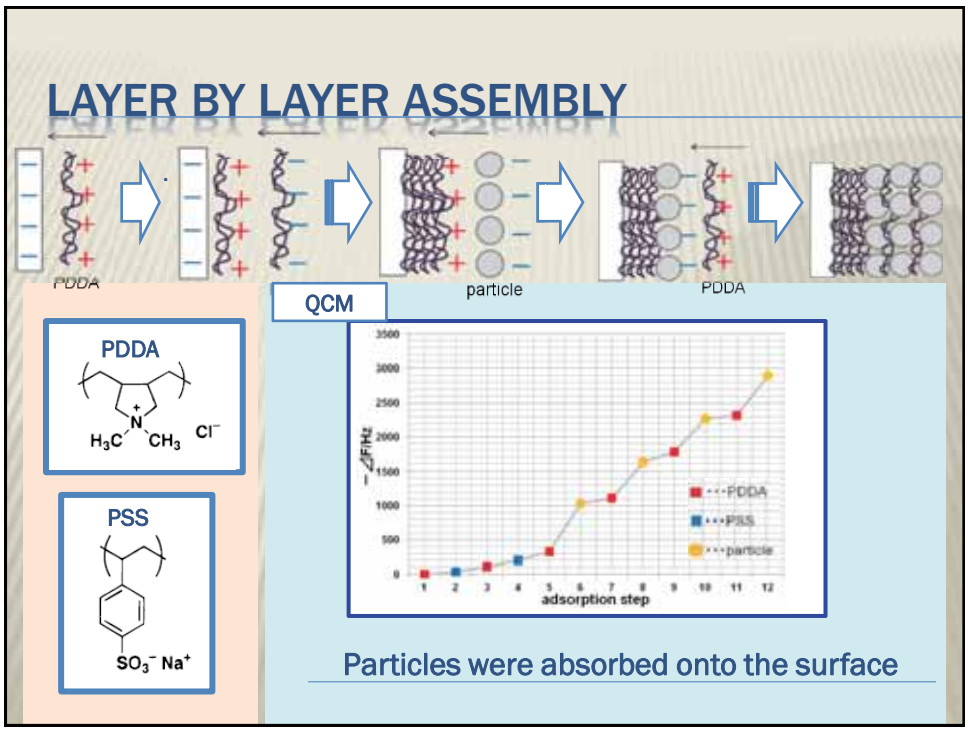

APPROACH
Nanoparticle
particle diameter 1~100nm
visible light λ=400~800nm
not light scattering
suitable for antireflection film
Mesoporous Silica Nanoparticles
20~30nm
▪ refractive index of silica is low
▪ the density of mesoporous structure is low
▪ particle strength is high
Layer by layer Assembly
burning
polymer
particle
Benefits of this approach
▪ low cost and environmental burden is small
▪ film thickness can be controlled by the nanometer
▪ adaptable to various surface states of glass substrates
▪ a capacity for resisting heat (composed only of inorganics)

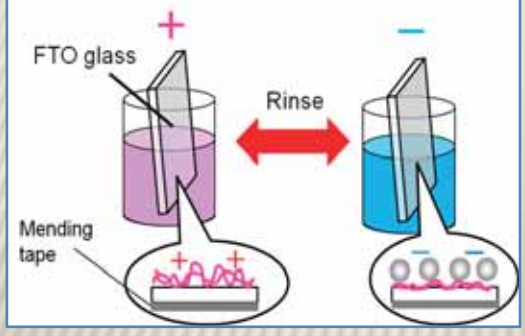

SYNTHESIZE MESOPOROUS SILICA - ①
CTMABr
TEA
TMOS
water bath
80℃
30min
water bath
80℃
2h
CTMABr
TEA
TMOS
TEM
DLS
▪ mean diameter ▪ ▪ ▪ 32.8nm
▪ zeta-potential ▪ ▪ +82.0.mV


SYNTHESIZE MESOPOROUS SILICA - ②
dialysis
. removal of surfactants
mesoporous silica
+ (surfactants)
acetic acid / EtOH
water
mesoporous silica
IR
Before dialysis
After dialysis
Transmittance/a.u.
C-H
4000 3500 3000 2500 2000 1500 1000
Wavenumber/cm-1
TEM
DLS
▪ mean diameter ▪ ▪ ▪ 33.5nm
▪ zeta-potential ▪ ▪ - 37.3mV

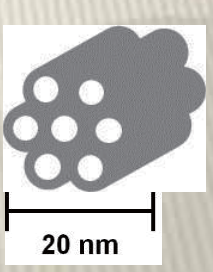

LAYER BY LAYER ASSEMBLY
PDDA
particle
PDDA
QCM
PDDA
PSS
adsorption step
PDDA
PSS
particle
Particles were absorbed onto the surface

FTO + AR

Coating process



Coating material



Layer by layer assembly

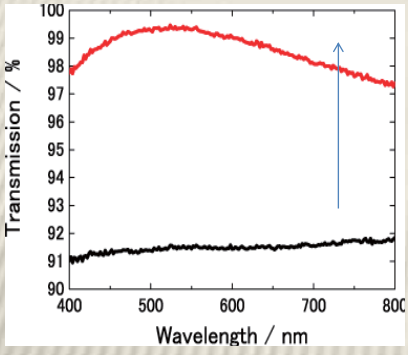
- thickness control is easy
- low cost
- mass production
- flexibility

Mesoporous silica

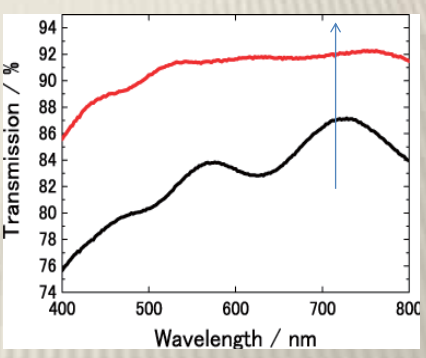
- high dispersion
- low reflective index
- high particle strength

GLASS + AR: TRANSMISSION

Glass



FTO glass



Glass Glass + AR

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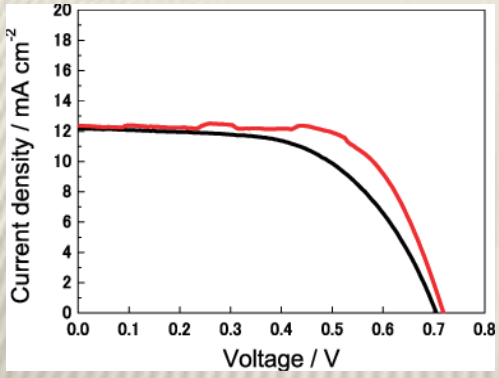
Shinichiro Yamazaki

I-V CURVES



DSC η = 5.702 [%]

DSC + AR η = 6.036 [%]

Efficiency increase by 0.3 %

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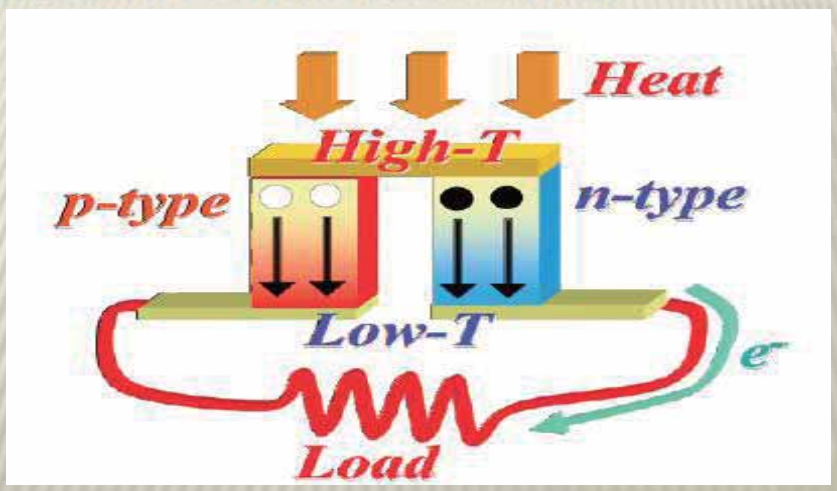
Shinichiro Yamazaki

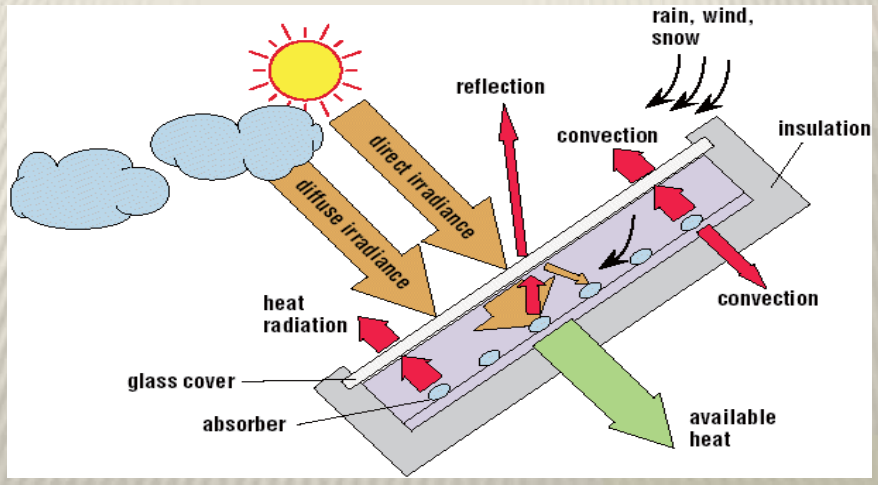
THERMOELECTRIC GENERATOR



Michitaka Ohtaki et al., Kyushu University

Sajeev Gulyani
Shinichiro Yamazaki

SELECTIVE SOLAR ABSORBER



(Picture downloaded from the web)

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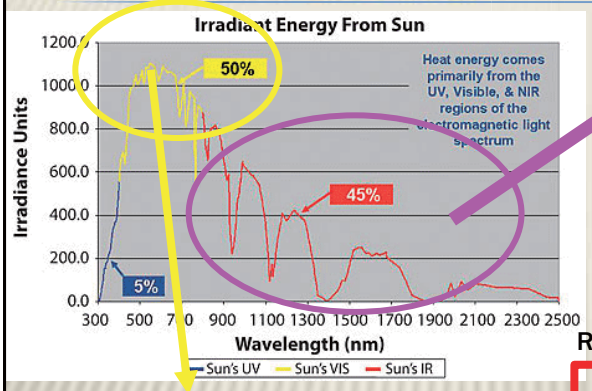
HYBRID SOLAR DEVICE



Thermoelectric device

Research subject

Hybrid Solar Power Generator

- *Crystalline silicon Solar Cells*
- *Silicon based thin film Solar Cells*
- *Dye-Sensitized Solar Cells*

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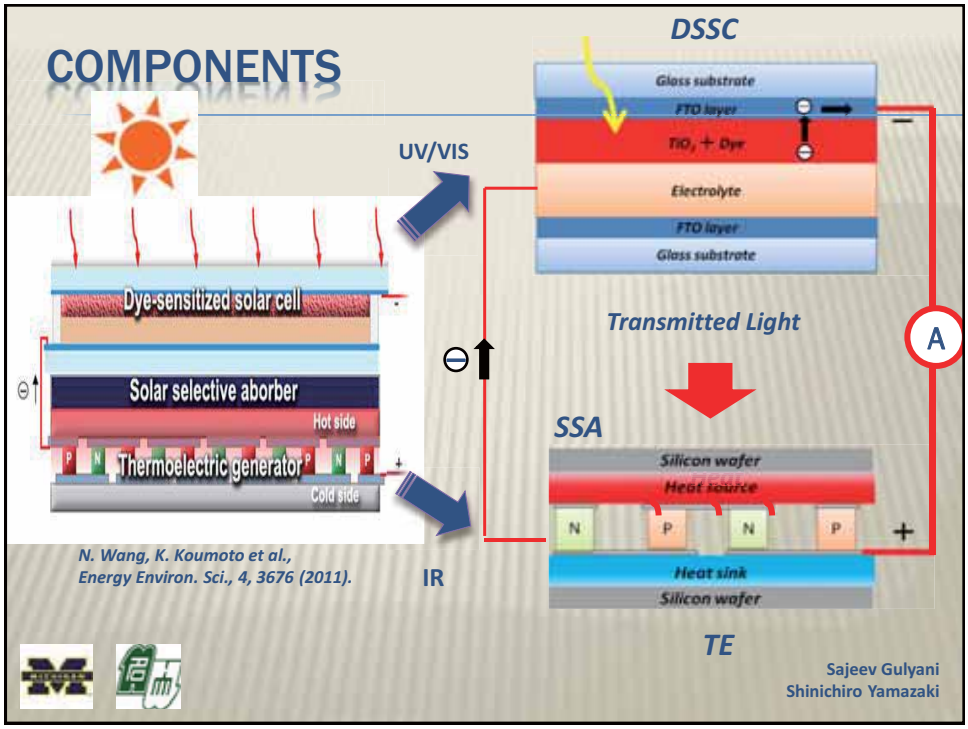
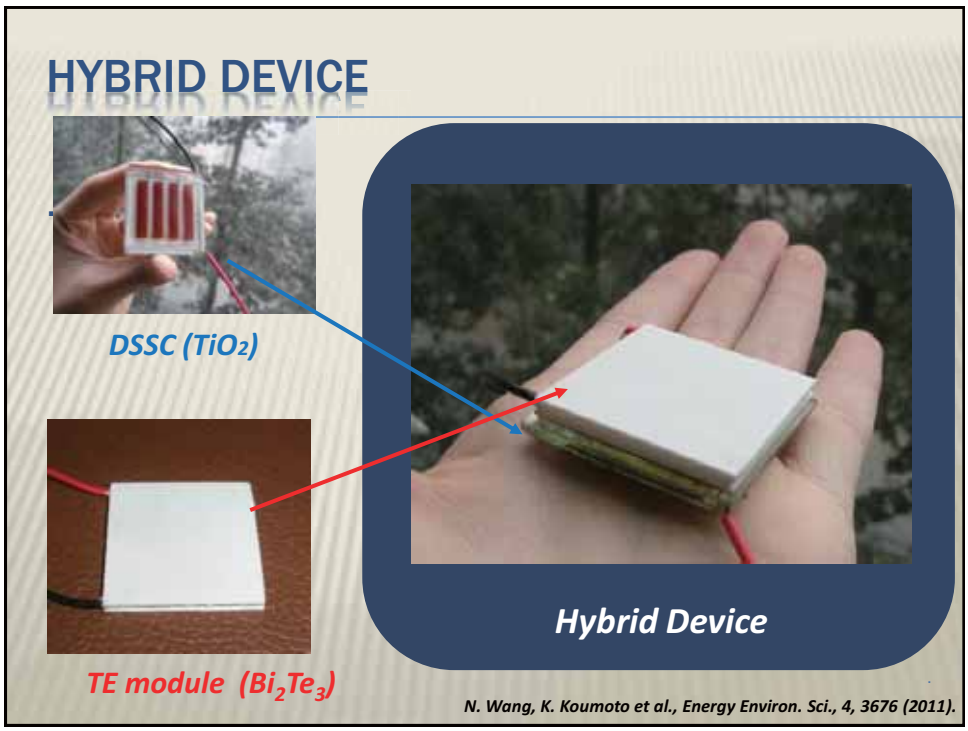
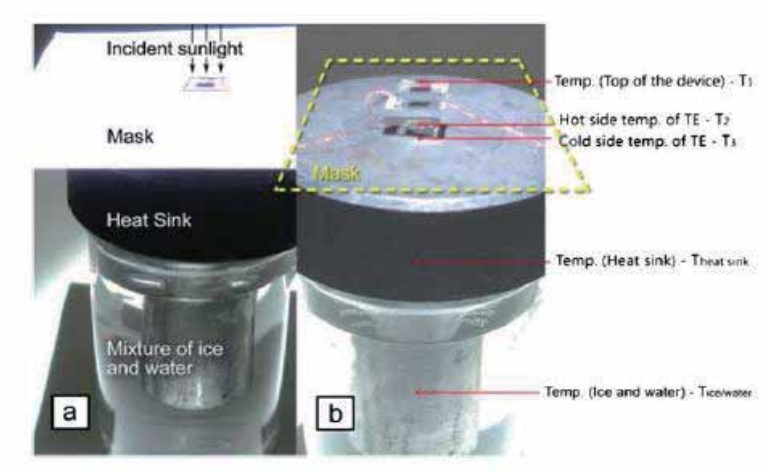

COMPONENTS
DSSC
Glass substrate
FTO layer
TiO2 + Dye
Electrolyte
FTO layer
Glass substrate
UV/VIS
Dye-sensitized solar cell
Solar selective aborber
Hot side
Thermoelectric generator
Cold side
Transmitted Light
A
SSA
Silicon wafer
Heat source
N
P
N
P
Heat sink
Silicon wafer
IR
TE
N. Wang, K. Koumoto et al.,
Energy Environ. Sci., 4, 3676 (2011).
Sajeev Gulyani
Shinichiro Yamazaki


HYBRID DEVICE
DSSC (TiO2)
TE module (Bi2Te3)
Hybrid Device
N. Wang, K. Koumoto et al., Energy Environ. Sci., 4, 3676 (2011).

EXPERIMENTAL SETUP

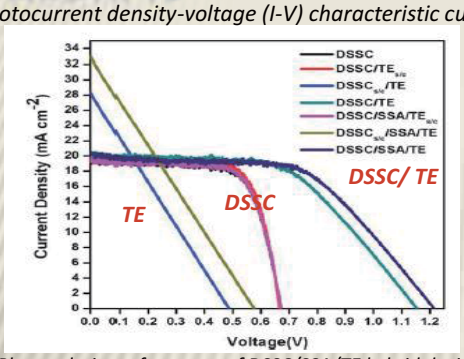


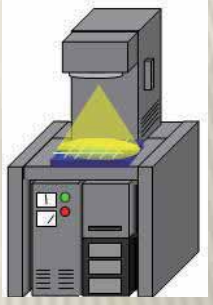
N. Wang, K. Koumoto et al., Energy Environ. Sci., 4, 3676 (2011).

Sajeev Gulyani
Shinichiro Yamazaki

RESULTS

Photocurrent density-voltage (I-V) characteristic curves





Solar simulator

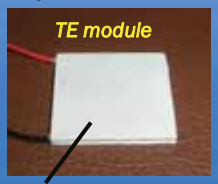
Photovoltaic performance of DSSC/SSA/TE hybrid device (AM 1.5G ,100mW cm^{-2} ambient temperature)

Test device	η (%)	V_{oc} (V)	J_{sc} (mA cm^{-2})	P_{max} (mW cm^{-2})
DSSC	9.26%	0.670	19.2	9.26
DSSC/SSA/TE$_{s/c}$ (DSSC contribution)	9.39%	0.671	19.7	9.39
DSSC$_{s/c}$/SSA/TE (TE contribution)		0.576	33.0	4.75
DSSC/SSA/TE	13.8%	1.21	20.3	13.8

N. Wang, K. Koumoto et al., Energy Environ. Sci., 4, 3676 (2011).

NEXT STEP

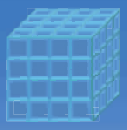
① Development of TE Materials



Bi_2Te_3

- toxicity
- expensive

- non-toxicity
- cheap



STO

TiS_2

② Improve performance of Hybrid device

Conversion efficiency

η (%) = 13.8

?

IMPACT

- A highly efficient photoelectric conversion is expected of a hybrid PV-TE device composed of a DSSC, SSA and TEG.
- Room for improvement by further optimization.

Sajeev Gulyani
Shinichiro Yamazaki

30th, August

FRICTION AND WEAR ANALYSIS ON DLC SPECIMEN USING AUTOMOTIVE GRADE OIL AND ADDITIVES

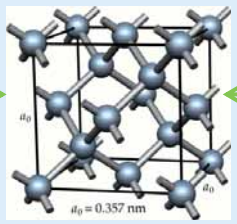
NANDAGOPALAN VENKATARAMANAN,
UNIVERSITY OF MICHIGAN,
JUACEP PROGRAM 2012

BACKGROUND

WHAT IS A DLC COATING?

- 'Diamond Like Carbon' coating
- Structure and properties similar to diamond

Diamond



DLC coating

- Deposited using physical and chemical methods

BACKGROUND

PROPERTIES OF DLC COATINGS

- Superior hardness (70 – 90 GPA)
- Low friction coefficient ($\mu < 0.1$)
- High scratch resistance
- Low wear rate
- High thermal resistance
- Chemical inertness

BACKGROUND

APPLICATIONS

- Cutting tools, Magnetic recording tapes, Medical implants, Microelectronics etc.
- Automotive engine coatings : Piston rings, Cam followers etc.

PROBLEM STATEMENT

Nissan Motor Co. uses DLC coated piston rings in its engines to :
- Reduce friction
- Reduce wear
- Improve fuel efficiency

- Different combinations of base oil and additives are experimented to see which gives the least friction and wear.
- Mechanism for the least friction and wear is proposed.

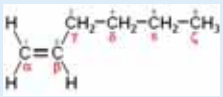
FRICTION AND WEAR TEST

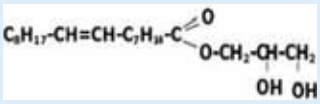
- TEST SPECIMENS :

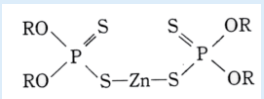
  DLC/Steel Disc Vs DLC/Steel Pin

- BASE OIL & ADDITIVES :

  PAO + GMO + ZnDTP





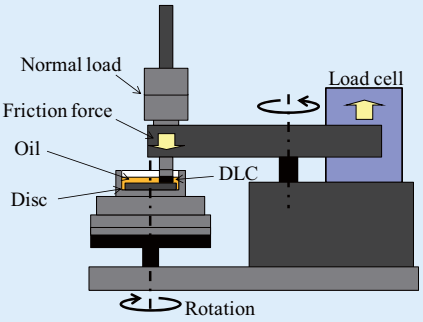


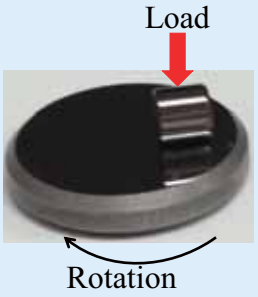
- Poly Alpha Olefin
- Base oil

- Glycerol Mono Oleate
- Friction Modifier

- Zinc Di Thio Phosphate
- Anti wear additive

FRICTION AND WEAR TEST





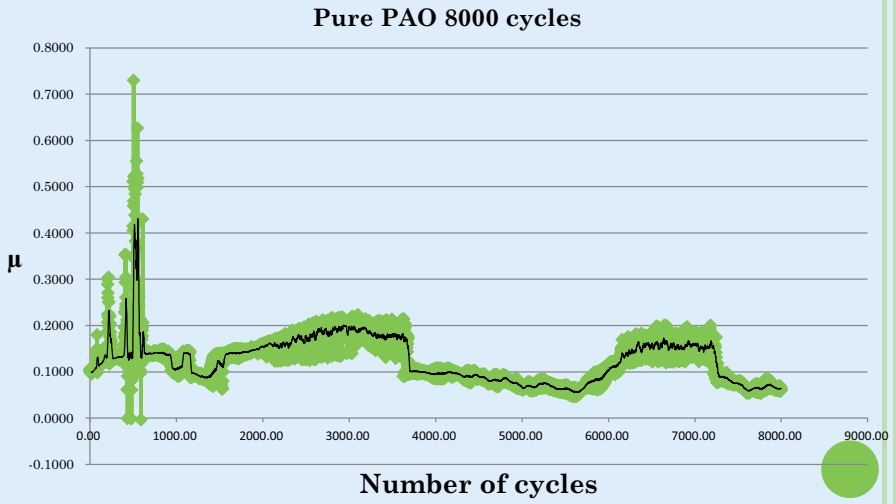
Test Conditions:

- Load Applied : 5N
- Rotation speed : 160 rpm or 0.1 m/s
- Rotation radius : 6 mm
- Oil temperature : 80° C
- Number of cycles: 2000 - 10000

Load cell measures the Normal reaction from which the co-efficient of friction is calculated

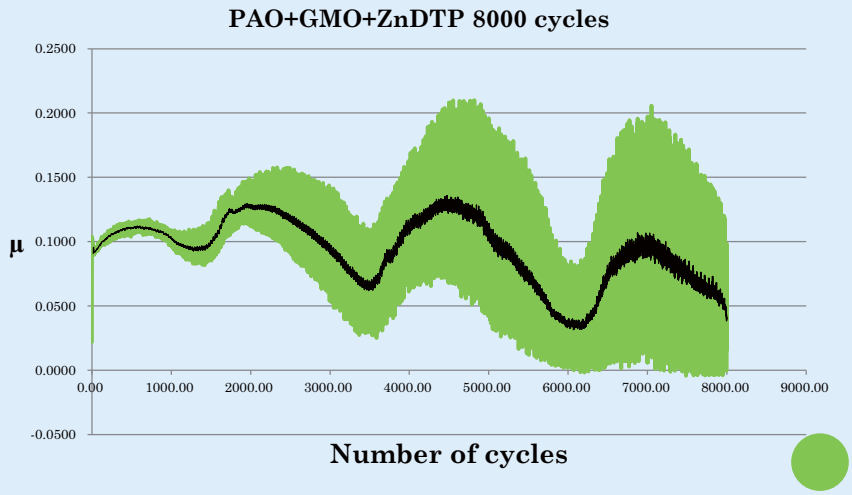
RESULTS

1) COEFFICIENT OF FRICTION:



RESULTS

1) COEFFICIENT OF FRICTION:



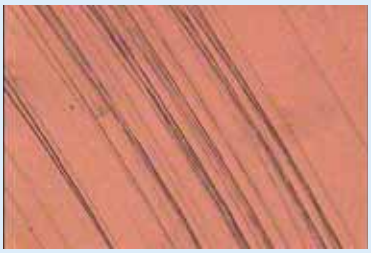
RESULTS

2) WEAR :

- Optical microscope is used

DISC WEAR

DLC Disc Vs Steel Disc



- Minimum or no wear
- Just buffing of surface observed
- DLC surfaces are hard & scratch resistant

- High wear
- Deep wear grooves observed
- Steel surfaces are softer and easily scratched by DLC

Experiment conditions : 8000 Cycles, Pure PAO Conditions

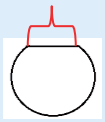
RESULTS

2) WEAR :

PIN WEAR

Wear thickness is an indicator of the wear rate of the specimen

Pin cross section before test



Pin cross section after test

DLC pin on DLC disc Vs DLC pin on Steel disc

- Wear thickness is 50 Micron
- Specimen has low wear rate
- No delamination

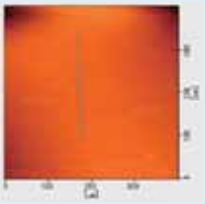
- Wear thickness is 120 Micron
- Specimen has low wear rate
- Delamination has occured

Experiment conditions : 6000 Cycles, Pure PAO Conditions

OTHER RESULTS

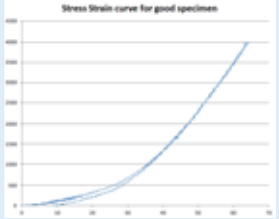
3) SURFACE ROUGHNESS :

- Atomic Force Microscope is used for measurement



4) HARDNESS :

- Nanoindenter is used for measurement



CONCLUSION

Systematic set of experiments were carried out on the different combinations of oils and lubricants and the following was concluded:

1) Interactions of lubricants with DLC is a complex phenomenon and extensive experiments must be conducted and repeated to come to concrete conclusions.

2) Certain anomalies from the expected behavior are observed and the mechanism for the same needs to be deduced.

3) It is very conclusive that DLC coatings bring down the coefficient of friction hence their use in the automotive application must certainly be considered.

ARIGATO GOZAIMASU..

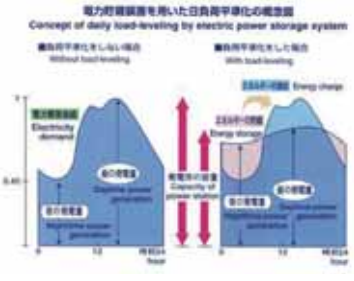
ANY QUESTIONS??

Demand Load Forecasting and Battery Scheduling Optimization

Research Results
Sean Bong
M.S.E in Mech. Eng.
30/08/2012

Introduction

- Load-leveling by price control (Demand-side Management)
  - Higher electricity price during peak times (Morning to Evening)
  - Lower electricity price during non-peak times (Midnight to Morning)
  - Incentive to use battery
    - Store electricity at night, use it during peak times
    - Efficient for both suppliers and consumers



Problem Statement

- Battery operation to ensure maximum efficiency
  - When to charge/discharge?
  - How long to charge?
  - Impact on cost?
- Scheduled battery operation based on past data
  - Scheduling for future results?

Objective

- Optimal Scheduling of Battery
  - Times and duration to charge the battery
  - Times and duration to discharge the battery
  - Minimization of Cost
  - Based on past historical demand data
- Demand Load Forecasting
  - Predict the electricity usage of the consumers
  - Use the forecasted demand
    - Schedule optimal battery usage

Previously – Battery Scheduling Optimization

- Utilized GAMS Linear Programming software
  - Calculate the times and duration of battery usage
- Different prices at each hour
  - Calculated for consumers by Smart Grid system
  - According to peaking demands and supplier capacity
- Compared cost of operation
  - Without battery usage
  - With optimized battery scheduling

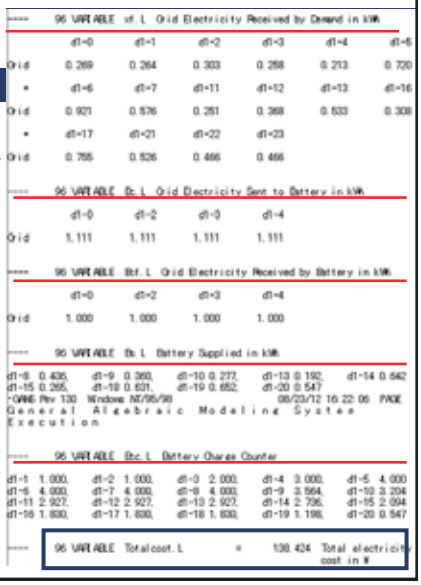
Battery Scheduling Example

- Example demand data on Nov 1st 2006
  - A single house
  - One day hourly demand data
- Price is assumed
  - Higher on peak times
  - Lower on non-peak times
- Assumed no battery is used

	Demand on 01/11/06	Assumed Price/hr (¥/kWh)	Cost/hr (¥)
dt-0	0.26087	7	1.88209
dt-1	0.263718	7	1.846026
dt-2	0.30258	6	1.81548
dt-3	0.25784	6	1.54704
dt-4	0.213318	6	1.279908
dt-5	0.719726	18	12.955068
dt-6	0.920893	20	18.41786
dt-7	0.576091	20	11.52182
dt-8	0.392352	22	8.631744
dt-9	0.32395	23	7.45085
dt-10	0.249057	23	5.728311
dt-11	0.250953	20	5.01906
dt-12	0.367801	18	6.620418
dt-13	0.70569	21	14.81949
dt-14	0.577432	22	12.703504
dt-15	0.238069	21	4.999449
dt-16	0.307536	20	6.15072
dt-17	0.754886	18	13.587948
dt-18	0.568078	24	13.633872
dt-19	0.58665	23	13.49295
dt-20	0.491936	23	11.314528
dt-21	0.526088	16	8.417568
dt-22	0.465664	10	4.65664
dt-23	0.46642	8	3.73136
			Total Cost
			192.223704

Battery Scheduling Results

- Assumptions:
  - 4 kWH battery, 1 kW AC/DC & DC/AC inverter
  - 90% Battery efficiency
  - Negligible battery self-discharge
  - Hourly analysis
- Comparison
  - Without Battery: 192 Yen
  - With Optimized Battery: 138 Yen
  - Approximately 54 Yen saved in one day
  - Depends on
    - Battery and Inverter capacity
    - Demand Data
    - Daily Electricity Price
    - Efficiency, etc.



```
---- 96 VARIABLE Grid.L  Grid Electricity Received by Demand in kWh
              d1-0       d1-1       d1-2       d1-3       d1-4       d1-5
Grid       0.269      0.264      0.303      0.258      0.213      0.720
   "       d1-6       d1-7       d1-11      d1-12      d1-13      d1-16
Grid       0.921      0.576      0.251      0.368      0.533      0.308
   "       d1-17      d1-21      d1-22      d1-23
Grid       0.755      0.526      0.466      0.466

---- 96 VARIABLE Etc.L  Grid Electricity Sent to Battery in kWh
              d1-0       d1-2       d1-3       d1-4
Grid       1.111      1.111      1.111      1.111

---- 96 VARIABLE Btr.L  Grid Electricity Received by Battery in kWh
              d1-0       d1-2       d1-3       d1-4
Grid       1.000      1.000      1.000      1.000

---- 96 VARIABLE Etc.L  Battery Supplied in kWh
d1-8  0.435,    d1-9  0.360,    d1-10 0.277,    d1-13 0.192,    d1-14 0.642
d1-15 0.265,    d1-18 0.631,    d1-19 0.652,    d1-20 0.547
GAMS Rev 130  Windows NT/95/98                  08/23/12 16:22:05  PAGE
General Algebraic Modeling System
Execution

---- 96 VARIABLE Etc.L  Battery Charge Counter
d1-1  1.000,    d1-2  1.000,    d1-3  2.000,    d1-4  3.000,    d1-5  4.000
d1-6  4.000,    d1-7  4.000,    d1-8  4.000,    d1-9  3.564,    d1-10 3.204
d1-11 2.927,    d1-12 2.927,    d1-13 2.927,    d1-14 2.796,    d1-15 2.004
d1-16 1.830,    d1-17 1.830,    d1-18 1.830,    d1-19 1.198,    d1-20 0.547

---- 96 VARIABLE Totalcost.L          =      138.424  Total electricity
                                                     cost in ¥
```

Load Forecasting Introduction

- An estimate of power/electrical demand
- Three types of forecasting duration
  - Long, middle and short term forecasting
- Different models of forecasting
  - Statistical Approach (Historical)
  - Econometric Models (Factors influencing consumption)
    - Weather, Price, Work-Time, Public Holidays, Etc.
  - End-use Models (Customer energy usage)
    - Consumers electrical appliances, age, size of house, Etc.

Previous Method – Morita's Method

- Developed by previous Prof. Suzuoki's lab student – Mr. Kei Morita
- Day-by-day forecasting
  - 4 main patterns calculated as candidates
    - Avg. demand of the same day of the week in the last 4 weeks
    - Avg. demand of the last 7 days
    - Same demand pattern as yesterday
    - Demand pattern when no one was in the house
- At the end of forecasted day
  - Real demand compared with all 4 candidates
  - Best candidate option is noted
  - Most frequent candidate in the last 7 days used for next day forecasting

Method – Base Forecast

- Calculate average of each day
  - Find values above and below average
  - Average the high and low values
  - Find shifted average
- Repeat the process using shifted average
  - Stop until above and below average values constant
  - Real average of high and low values
- Calculate Base Forecast
  - Use previous week data
  - Determine peak and non-peak hours (high and low)
  - Average past data with high/low average correspondingly

Real	Wed
	11/1
0	0.26887
1	0.263718
2	0.30258
3	0.25784
4	0.213318
5	0.719726
6	0.920693
7	0.576091
8	0.392352
9	0.32395
10	0.249057
11	0.250953
12	0.367801
13	0.70569
14	0.577432
15	0.238069
16	0.307536
17	0.754886
18	0.568078
19	0.58665
20	0.491936
21	0.526096
22	0.465664
23	0.46642
Total	10.79561
Average	0.449817
High Avg 1	0.613297
Low Avg 1	0.286337
Shifted Avg 1	0.449817

Base Fcst	Wed
	11/8
0	0.277604
1	0.275028
2	0.294459
3	0.272089
4	0.249828
5	0.666512
6	0.767095
7	0.594694
8	0.339345
9	0.305144
10	0.267697
11	0.268645
12	0.327069
13	0.659494
14	0.595365
15	0.262203
16	0.296937
17	0.684092
18	0.590688
19	0.599974
20	0.552617
21	0.569698
22	0.539481
23	0.539859

Method – Hourly Forecast

- Algorithm
  - Use Base Forecast as first hour forecast
  - Calculate difference with real demand on current hour
  - Add the difference value to a counter
  - Check value of counter and its sign
    - Value determine the percentage change for next iteration
    - If positive, increase the next hour usage, vice versa
  - Increase/decrease next hour forecast by determined percentage
  - Repeat the algorithm

Method – Hourly analysis

Time (Hr)	Forecast	Real		2nd Meth		Real Diff	Counter	Quotient
	Thu	Thu		Thu		Thu	Thu	Thu
	11/2	11/2		11/2		11/2	11/2	11/2
0	0.354169	0.368468		0.354169		-0.0143	-0.0143	0
1	0.349733	0.257126		0.349733		0.092607	0.078308	0.1
2	0.32497	0.253146		0.292473		0.039327	0.085138	0.1
3	0.339888	0.240402		0.305899		0.065497	0.116647	0.1
4	0.627126	0.585372		0.564414		-0.02096	0.032976	0
5	0.286728	0.687364		0.286728		-0.40064	-0.36766	-0.4
6	0.310226	0.624999		0.434316		-0.19068	-0.43425	-0.4
7	0.2827	0.452978		0.39578		-0.0572	-0.37837	-0.4

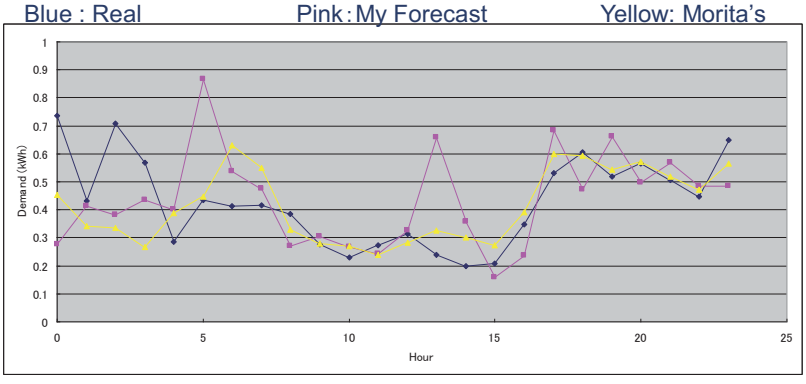
Results

	Wed	Thu	Fri	Sat	Sun	Mon	Tue
	11/1	11/2	11/3	11/4	11/5	11/6	11/7
Morita's Method							
Abs. Total Diff	1.507262	0.345608	0.283851	0.561385	0.652748	0.545831	0.093529
Abs. Average Diff	0.127092	0.085591	0.112413	0.102397	0.092728	0.100377	0.105051
My Method							
Abs. Total Diff	0.881831	0.164941	0.738149	0.093118	0.748425	0.048516	0.468234
Abs. Average Diff	0.120029	0.091221	0.142169	0.133675	0.094935	0.091555	0.122013

	Wed	Thu	Fri	Sat	Sun	Mon	Tue
Morita's Method	11/8	11/9	11/10	11/11	11/12	11/13	11/14
Abs. Total Diff	0.330711	1.055749	1.580247	1.618456	1.474408	1.304187	0.828574
Abs. Average Diff	0.091734	0.125187	0.172392	0.187998	0.114322	0.105491	0.110849
My Method							
Abs. Total Diff	0.172293	0.319321	0.605786	0.687215	0.517087	0.095387	0.497849
Abs. Average Diff	0.141285	0.1538	0.146001	0.132255	0.09786	0.109086	0.111651

Results - Continued

Blue : Real Pink : My Forecast Yellow: Morita's

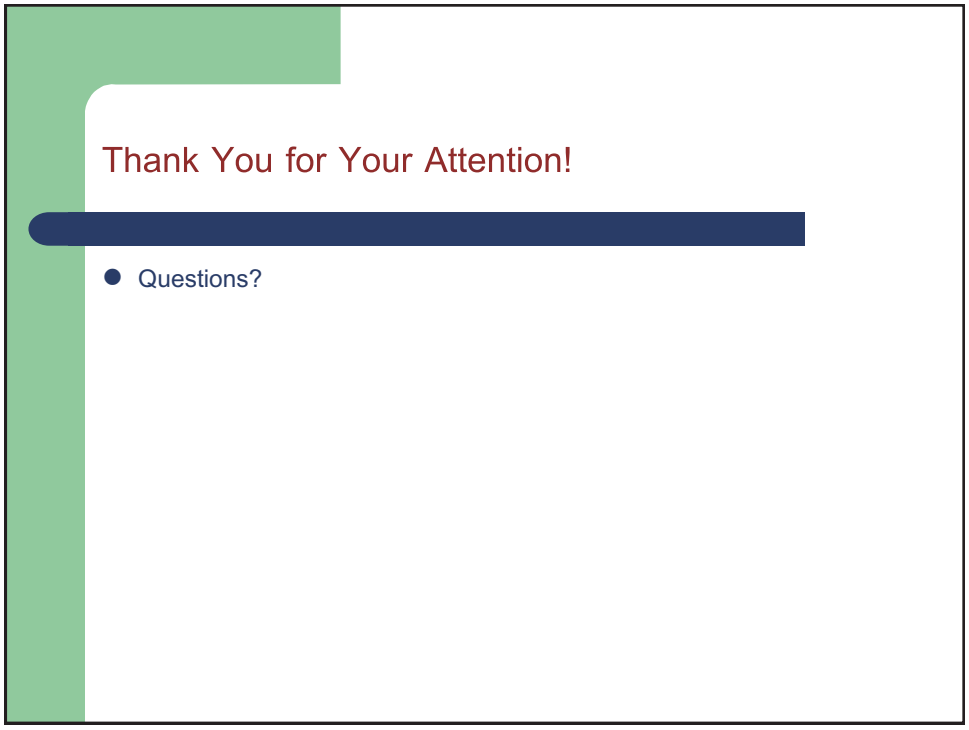


Results - Continued

- Morita method
  - Minimize average difference in each hour
  - Able to forecast a day in advance
  - Uses moving average and cyclical patterns
- My method
  - Minimize total in each day
  - Hour-by-hour analysis
  - Uses previous week's pattern and difference rectification

Advantages and Disadvantages

- Able to obtain a better estimate total electricity usage
  - Decrease wastage or shortage of electricity for consumers
- Unable to forecast 24 hrs ahead accurately
  - Unable to use my program to schedule battery optimization
  - In the future, develop hourly battery optimization
- Data storage for forecasting is very small
  - Requires only previous week values for average computation
- Hourly difference is not optimal
  - Might result in higher electricity cost

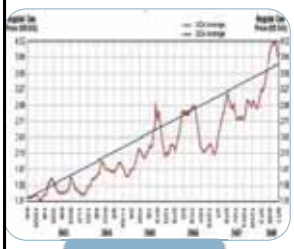

Thank You for Your Attention!
Questions?

NEXT-GENERATION BATTERIES FOR STATIONARY APPLICATIONS

Qiongyu Lou
Department of Mechanical Engineering,
University of Michigan
Takato Mitsuhashi
Department of Material Science Engineering,
Nagoya University
JUACEP 2012 Program at Nagoya University

ENERGY PROBLEM

Oil Price Increases by decades



Energy Crisis

More Renewable Energies

- Hydro Power
- Geothermal Power
- Wind Power
- Photovoltaic

Power dispatch

Huge Energy Storage----Next-Generation Batteries for Stationary Applications

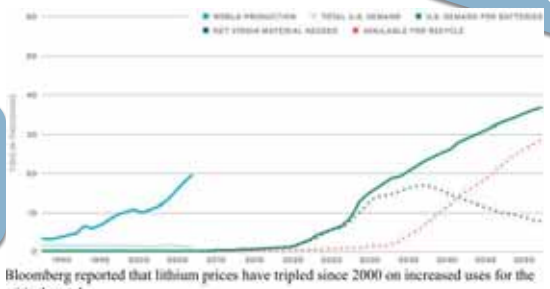
THE SHORTAGE OF EXSITING BATTERY

The mid-1990s brought a new kind of secondary cell---- -- the lithium ion polymer battery

✔ Mobile
✗ Large stationary application

Lithium prices increase by year

100~1000 times more expensive than other candidate metals



Bloomberg reported that lithium prices have tripled since 2000 on increased uses for the critical metal.

Metal (Bulk)	Mg	Zn	Al	Fe	Na	Ca	Li
Cost (USD/kg?)	3.1	2	2.53	0.37-0.55	2.6-3.0	3.9	600

LET'S FIND THE BEST MATERIAL FOR ANODE

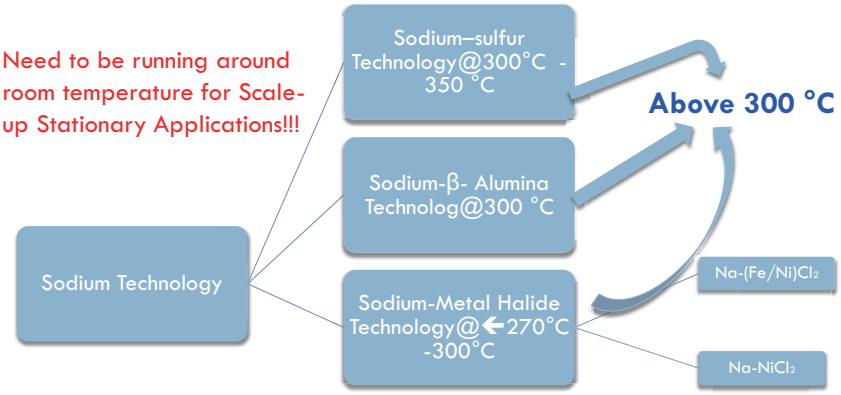
Top 10 characters
Cost ($/kg?)
Identified resource
Hydrogen evolution
Cycle life
Running temperature
Over potential for the anode
Energy density (Wh/kg)
Energy density (Wh/L)
Power density (W/kg)
Energy efficiency
Self discharge rate (shelf life)
Reaction Voltage (vs. hydrogen) Electrolyte
Cathode

Sodium — Failed

1. high energy density ✔ 2. high efficiency of charge/discharge (89–92%) ✔ 3. long cycle life ✔ 4. is fabricated from inexpensive materials ✔

✗ High operating temperature→problems of thermal management and safety

Need to be running around room temperature for Scale-up Stationary Applications!!!



Iron — Failed

COMPARASION OF TWO MAJOR IRON BATTERIES

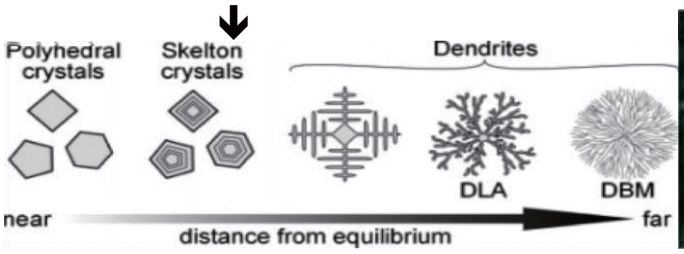
Metal	Fe(Iron/silver oxide)	Fe(Iron/air)
Reaction	Fe + 2OH−→ Fe(OH)2 +2e−,	Fe + 2OH−→ Fe(OH)2 +2e−,
Voltage (vs. hydrogen)	-0.44	-0.44
Electrolyte	alkaline solutions	ocean water(water-activated)
Cathode	silver oxide	air
Running temperature(UP TO 100 C)	400-600 C	400-600 C
Energy density (Wh/kg)	60-75	1200
Hydrogen evolution	yes	yes
General advantages	High energy density/High cycle life	Good energy density/Uses readily avauable materials/Low self-discharge
General disadvantages	Low cell votage/High cost/Hydrogen evolution on charge	Low efficiency/Hydrogen evolution on charge/Poor low-temperature performance

Zinc — Failed

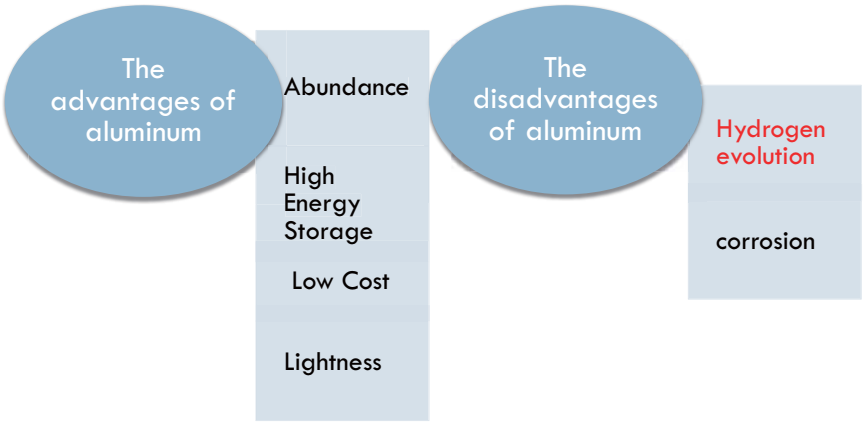
Transition of zinc deposition over cycle ➔

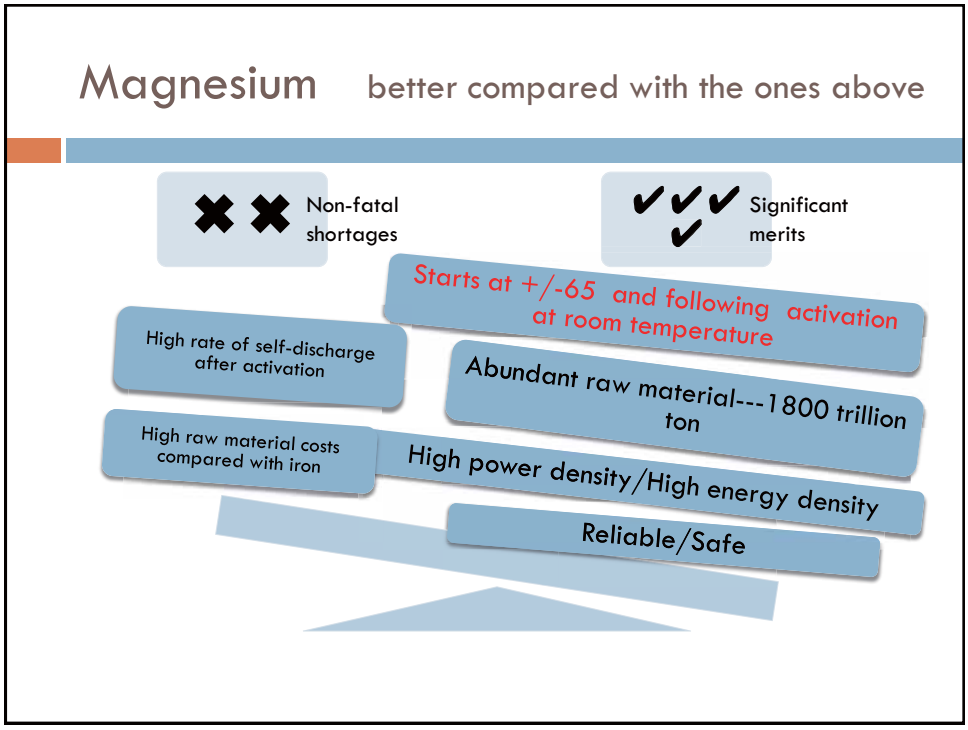
Short life cycle time due to **dendrites** on charging

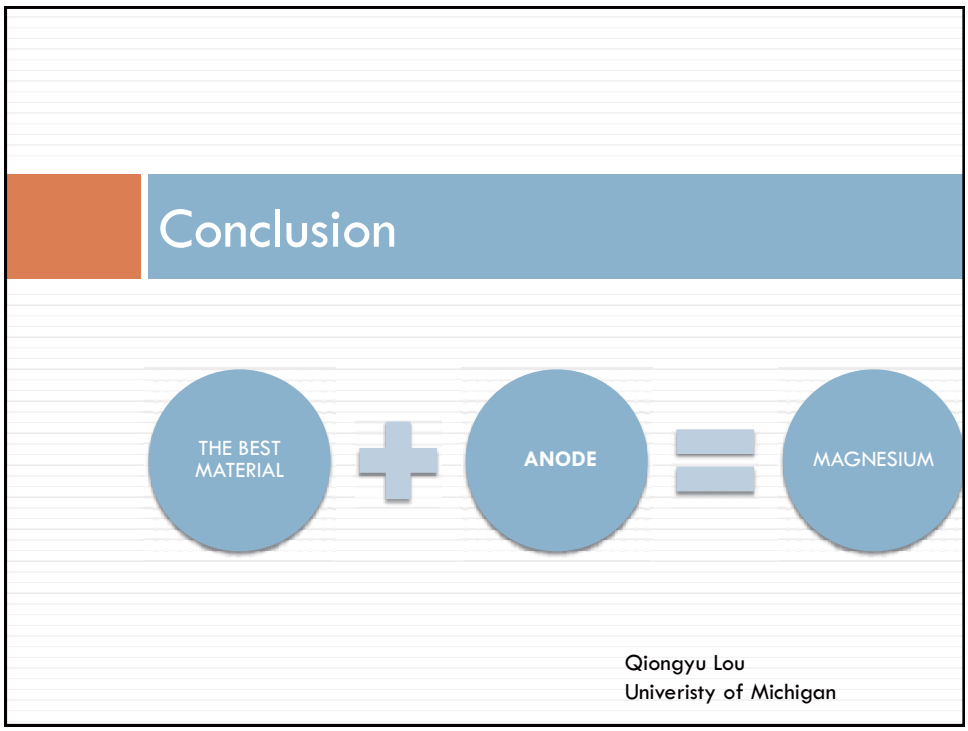
Gas evolution in battery ➘



Alumina — Failed




Magnesium
better compared with the ones above
Non-fatal shortages
Significant merits
Starts at +/-65 and following activation at room temperature
High rate of self-discharge after activation
Abundant raw material---1800 trillion ton
High raw material costs compared with iron
High power density/High energy density
Reliable/Safe


Conclusion
THE BEST MATERIAL
ANODE
MAGNESIUM
Qiongyu Lou
Univeristy of Michigan

<3>
Reports

*The reports have been written as the JASSO (Japan Student Services Organization) scholarship report and approved to publish on here.

JASSO Scholarship Report

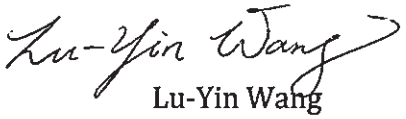
Recognizing Japan as a global leader in science and technology, I am very glad to be a part of this summer scholarship program. As a master's student of Aerospace Engineering at the University of Michigan, Ann Arbor, I am committed to applying my engineering knowledge to the real-world scenario while learning professional and interpersonal skills with the faculty and my fellow students of Mechanical Engineering at Nagoya University, Nagoya, Japan.

Under the instruction of my teaching assistant, we performed several experiments in the regular and fractal square grid turbulence. The velocities of flows and the concentrations of Rhodamine B were measured simultaneously by means of PIV (Particle Image Velocimetry) and PLIF (Planar Laser Induced Fluorescence). Albeit, I took a turbulent flows course before, I was not very familiar with the details of this experimentation. Hence I had to catch up by reading many related papers published by the professors of Nagoya University as well as by the researchers of Imperial College London, and I presented the paper summary at our weekly meetings. In order to fully understand the physics, I reviewed, reviewed and reviewed. Little by little my vague picture of turbulence became clearer. Especially the moments when professor stopped my talk to ask me questions, I learned the most. No doubt the faculty and students of Nagoya University have strong physical understanding and engineering aptitude. My research project in Japan has significantly stimulated my interest in further studying turbulence.

JASSO Scholarship Program not only offered me a great opportunity to learn how to be a good researcher, but also provided me with many valuable lectures and automotive factory visits. Located in Aichi Prefecture, Nagoya being surrounded by automotive industry, like Toyota, Lexus, Mitsubishi, etc. implies how much people can benefit from this prosperous city. Indeed there were many lectures in this program given by the engineers from Toyota and its luxury brand, Lexus. We also visited assembly lines in Toyota and Mitsubishi factory and were all amazed by the robotic workers, especially the robot trumpetist performing *somewhere over the rainbow* in the lobby of Toyota museum! Besides automotive field, the topics of the lectures mainly focus on renewable energy technologies, in the wake of Fukushima disaster, making me become much more aware of this issue. Topics include smart grid framework, electric car overview, fuel cell car development, next-generation batteries exploration, etc. To be more involved in this field, I am also seeking engineering jobs in some green energy companies like Xcel Energy.

Living in Japan is not easy if one doesn't know Japanese. Another highlight of this program was the Japanese course. Our Japanese teachers were so patient, kind and experienced that I learned not only the language but also from their positive attitude. They helped me walk through the tough period every beginner encounters, and now I have grasped the tips to learn Japanese and its deep culture.

After studying in Japan under the aegis of JASSO scholarship, I have become more passionate about research. At this juncture of my life, though the future is uncertain, I am confident that my drive, commitment, and enthusiasm I have gained in this program will lead me to a better life.



Lu-Yin Wang
Aerospace Engineering
University of Michigan, U.S.A.

August 24, 2012

JUACEP STUDENT EXCHANGE REPORT

Mudit Rastogi,
MSE, Mechanical Engineering,
University of Michigan, Ann Arbor, USA
Nagoya University, Nagoya, Japan (1 July – 31 Aug, 2012)

Aug 21, 2012

I am a graduate student at University of Michigan and in July 2012 I had one of my most memorable life experiences. I embarked on a student exchange program called JUACEP to Nagoya, Japan. This is indeed the furthest I had travelled to the east. I was always fascinated with the Japan and wanted to travel here since I was a kid. It offers temples, shrines, beautiful Japanese gardens; kabuki, the treasured form of theater utilizing intricate scenery, costumes, and makeup; sumo wrestling and kendo, the sword fighting of the samurai. And then there is Japanese art, from woodblock printing to tattooing. Sometimes this exchange program seems like a dream and I wish that this dream can last for one year or more instead of only two months so that I can learn more about this wonderful country. On a personal level, this exchange is a milestone of my life chapter, with ample experiences of interacting and making new friends with different cultural backgrounds.

Nagoya University is a renowned university and one of the former nine imperial universities. Though the campus is small as compared to UM but I found it well maintained and beautiful. Nagoya on the other hand is the third largest incorporated city in the Japan with magnificent temples, museums, shrines, markets and nightlife. In addition, on urban planning level, there are well preserved medieval buildings standing along modern architecture, which gives this city its charisma.

I chose Prof Iguchi Lab, Dept. of Quantum Engineering as my research lab. Coming from Mechanical Engineering background everything was very new to me, not to forget the cultural shock, language problem, food etc. But the students and my advisors took great pain to organize activities to let me settle in fast. These include activities like pub mingling evening (welcome party) to weekly seminars / presentations for me to get to know others and their areas of research. The fellow students in my lab were helpful and friendly who helped me in my experiments. However at times I feel they have a very limited scope of knowledge when it comes to world affairs, culture, geography and history. They are less curious in world affairs and hesitate to open up a conversation. I strongly feel they should work on overall intellectual development and not only in their technical field.

During my stay here in Japan for two months I travelled to different places like Kyoto (Gion Festival), Nara, Osaka, Tokyo, Tsukuba, Hakone, Fuji, Takayama and Kamikochi. I see that through all Japan's modernity runs a deep reverence for the past and a fervent belief in tradition that makes travel in this country a very positive and rewarding experience. Although 20th-century technology plays a powerful role in the daily life of the Japanese, most Japanese maintain a centuries-old tradition of hospitality and graciousness. If you can see the Western touch in Japan's urban areas, you can also find many glimpses into Japan's past in the traditional architecture and slower-paced lifestyle of the countryside. Most people when they think of Japan think of things like Mt Fuji, Bullet trains, sumo wrestlers, samurai warriors, tatami mats and sushi. Though I wanted to see all of them, I couldn't experience everything in these two months of my visit to Japan, but I had a good taste of Japanese life and culture by simply getting out on my own. Such everyday experiences like wandering the basement food halls of big department stores, riding the local trains and subways, freeloading with everyone else in the book stores, walking past noisy *pachinko* parlors and dodging the hundreds of bikes and riders on the footpaths - it's all a window onto the way ordinary Japanese go about their lives.

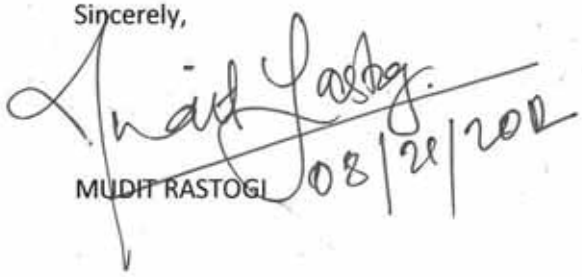
I had this opportunity to attend the Summer School on Radiation Detection at Tsukuba Science City. This was a great experience for me as I met people from different establishments like KEK, AIST, University of Tokyo, Shizuoka University etc. While talking to a senior researcher in AIST on Japanese culture and reason for its technology might, he told me a famous Japanese saying " 継続は力なり。" meaning "Perseverance is strength", which I think I will take back and remember all my life. I am happy that in those two days at Tsukuba, I learnt something about Japanese work ethics which will make me a better and successful person in future. There is so much to learn from Japan that will influence your life forever.

The beauty of the land, the changing views of Mount Fuji, and the contradictions and complexities of its culture are never forgotten.

It's now time to go back to my University in USA, but I must say I am reluctant to do that. It seems like I have just settled down to life properly in Japan and want to learn so much about this country. I must say that this program has been a memorable experience for me. My perspective of the world has broadened and character has been shaped to be more open minded and friendly. Given a chance I would love to come back to Japan to work, study or just simply to live life.

I would like to thank all of JUACEP team for giving me this opportunity, my lab mates for helping me in my study experiments and for the good time I had in lab. Many thanks and my gratitude to Prof Iguchi and Asstt. Prof H. Tomita for their kind guidance.

Sincerely,



MUDIT RASTOGI 08/21/2012

JUACEP SCHOLARSHIP REPORT

When it comes to seeing places and learning cultures around the world, I always thought that I have had good exposure. I expected the JUACEP program to be just another experience. But it turned out to be much more than that. I honestly admit that the Japanese aka 'Nihon' experience has been the best experience of my life. They say two months in not much of a time to transform a person, but I admit that these two months have transformed me and have made me a wiser and a more learned person. It is through the JUACEP program that I learned to strike the right balance between work and fun as opposed to the geek I was before. The most beautiful thing about the program was its structure. It was a harmonious mix of course work, research work and extracurricular activity. While the coursework was encompassing for the automotive freak that I am, the Japanese language classes were rigorous enough to acquaint me with the language which was so helpful in the five day tour of Japan I took all by myself. Thanks to both the Sensei for their effort. My research team was very co-operative and gave me freedom and space to do my work which made my research fun and interesting. The friends I made in the research group are friends for life and I will certainly come back to Japan often to meet and share a drink with them. I hope to return favor by showering hospitality on the Nagoya students who are currently in Michigan as part of the JUACEP program, once I get back there. The program was beautifully studded with field trips and factory visits which helped cut the monotony of the lectures and brought more flavor to the entire program.

Because of the JUACEP program, my enthusiasm towards a study abroad program has skyrocketed. Honestly my main motivation behind applying to the JUACEP program and coming to Nagoya University was academics; to build a good profile; a program like this would stand out on my resume. But, my thinking has changed now. If I were to apply for another study abroad program, it would certainly be for the cultural experience more than anything else! I am so mesmerized by Japanese culture right now that if I were to live here for a couple more months, I am sure to become a 'Nihonjin'. My accent has started to change for one;With all the Japanese conversation, I am starting to forget the English I know; I have started loving raw fish and I have become an anime fanatic. In fact, I think I will face a 'culture shock' scenario when I go back to Michigan. The land of the rising sun has given me new experiences and there is a lot I will take back home. Few of my first timers include my encounters with cars and their manufacturing (Toyota, Mitsubishi and Mazda plant visits); the experience of staying alone and having an entire home for myself; trying out exotic Japanese cuisine including Tacoyaki, Okonamiyaki, Unagi, Momaji Manju, Kobe beef and of course Japanese Sake; the experience of travelling Japan all by myself and managing to communicate with people with the little broken Japanese I know and most of all,getting inspired by the 'never say die' spirit of the Japanese people to rise up like a phoenix from disaster (Hiroshima bombing, Kobe Earthquake and recent Fukushima disaster).

So, in all, I have had the time of my life here and I will be carrying back memories which I can boast about to people for the rest of my life. In future, if any such study abroad opportunity opens up, I would be the first person to grab it with open arms. But, I am not sure if that experience would be as good as this one. I would also like to thank the JUACEP staff for being so amicable and warm in making us feel at home away from home! I just have one request. Please extend my program by another two months.....

Nandagopalan Venkataraman

V. Nandagopalan.

THE SCHOLARSHIP REPORT

JUACEP Summer Program 2012 at Nagoya University

I am one of the University of Michigan students participating JUACEP Summer Program at Nagoya University during July and August 2012. I am really impressed with this program that provides such a great opportunity to experience international study life. Before applying to this program, I have a lot of enthusiasm toward studying abroad in order to gain the familiarity of working with multi-cultural colleagues. This program could provide a concrete experience on that. During the 2-month program, there are several different tasks assigned to me. One of them is the intensive Japanese language class coming with 6 hours a week. Even though it seems to be tough and energy-consumed for newcomers like me, the very warm-welcomed environment from everybody at Nagoya University makes life here easier. The language class is very useful for living here because most of local people tend not to speak English. Additionally, it would also be beneficial for communication for international work in the days ahead. Besides, there are also technical lectures related to energy and automotive topics that are currently challenging issues. Those lectures, presented by experts in the related areas, broaden my viewpoint of new cutting-edge technologies very well. Furthermore, this program also gives a good methodology of conducting engineering research including hand-on experience. For my research theme, I am assigned to synthesize the diamond single crystals using high temperature and high pressure. Whereas I have not had the background in this area, I could learn it very fast because all of my lab-mates are very kind to help and explain unclear questions. With all of those, I feel that attending this program is one of the worth things in my life.

In short, this program is my first exchange-study program that really impresses me. I could gain great academic and social experiences and I am also very impressed with Japanese culture and their way of working life. This JUACEP program rises up my interest of studying or working abroad for the next possible opportunity.

Pattarawit Sae-Ong

Fall in love with JUACEP Program

It was my first time to attend the study-abroad program; it was my first time to come to Japan; it was my first time to get used to live at a foreigner language atmosphere; and it was my first time to get involved in the research field. All these first-times make my days in Japan. I would like to express my gratitude to JUACEP program and Mr. ITO-my supervisor who offer me this precious chance. Everything is new to me here and I did have a unique experience here. We learned Japanese language-ありがとうございました, and the more important thing is that we have our own supervisor to give us his advice on our academic improvement. I also need to mention that we have a one-credit lecture that is given by super professional lecturers who are from different academic

background. Besides studying variety of skills, we also had two expressive factories-visiting trips in Toyota and Mitsubishi that make us feel more about high-technique and engineering pride. I think I will come back Japan to seek another adventure after the JUACEP program.

At last, thank you for JUACEP program again to offer this adventure to us and I would like to attend more if there is another chance in the future.

Qiongyu Lou

Experiencing Japan

Japan is a unique country, a different world altogether, thriving on delicious contrasts of modernity and historically traditional. The people are warm, welcoming and incredibly polite. Home to an ancient civilization, a booming economy, a huge population, *Nihon-koku* (日本国) is the land of the rising sun.

Japanese people have always been known for their thoroughness and civility. Their ability to rebuild their country faster than anyone ever expected after the devastation by last year's earthquake and tsunami reflects their culture's highest virtues: Ganbaru- to commit oneself fully to a task and to bring that task to an end, working with perseverance and Gaman- enduring the seemingly unbearable with patience and dignity.

This spirit and their welcoming nature combined with the scenic beauty bestowed upon Japan by nature, makes it a veritable tourist paradise. Add to that their technological brilliance, and you get a travel sweet spot for an engineering student! So, when I received the Japan Student Services Organization (JASSO) scholarship to study in Japan over the summer, I poised myself to set off on a memorable journey to celebrate Japan and its people, to experience the unique magic of this country!

Japan never fails to surprise you. Travelling in Japan is a remarkable experience. From staying in a capsule inn to the traditional Japanese Ryokan, the very realistic plastic food displays outside Japanese restaurants, soaking naked in an Onsen with strangers, to sitting in a Yukata on Tatami mats eating fried fish and sushi, drinking hot sake with your teachers while enjoying yakitori, is something that you will remember for the rest of your life.

Japan is a good example of how the old and the new can coexist peacefully, side by side, working together. They adopted the western technology but never abandoned their culture. They expanded the horizon of knowledge, pushed the boundaries of science and technology but still preserved their ancient religion. Japan makes you wonder at every instance, how people can be so polite, civil, disciplined, never losing their temper, all the time. The very way they do things makes you awed.

Studying abroad in Japan is one of the most enriching, fulfilling, interesting and educationally stimulating experience of my entire life. This program gave me a chance to further my academic goals in a new country, allowing me to immerse myself in a new culture, a new language, making me aware of a whole new world altogether. This not only provided me with a global network of friends but also gave me a chance to learn more about myself in a new and exciting lifestyle. Globalizing myself helped me understand how me, as an individual, fits into this world.

Studying in Japan made me realize the importance of keeping my own traditions alive while sharing them with others. It made me see how my own homeland fits into this humanity, through the eyes of a different culture, making me able to precisely reflect on my own moral values and beliefs long held. I now see the world through a new set of eyes, more mature, tolerant, and realistic. This study abroad program has given me so much; I have learned so much, I am more than ready for my next opportunity to explore a new culture. I'll return home a wiser individual and ready to face any future challenges head on.

- **Sajeev Gulyani**, University of Michigan, Ann Arbor, USA

JASSO Report

Sean Bong

Nagoya University Experience

The whole experience is nurturing, eye-opening, culturally dazzling, breathtaking, and there are many more words to describe my wonderful experience in Nagoya University, Japan. The first step out from the airplane, I was positive that the whole experience was going to be a lovely and exciting one. The weather was hot and humid, much like my hometown in Indonesia, but to me it was the perfect weather and condition for an adventure and exploration.

As I explored Nagoya University for the first time, I was amazed at how the buildings are organized in an orderly fashion. The people in Nagoya University are helpful and friendly, greeting me with a kind of warmth that I would get back at home. I have been away from home for a month now, yet I do not feel much different at all with the kindness and warmth that the people in Nagoya University provide.

The campus was packed with liveliness and the sound of bustling students, walking around and chatting about their research lifts the whole ambience of the university. The professors are also curious about each of the students and carefully select assignments that would match the interest of the students and at the same time greatly benefiting them as well. One of the traits of Nagoya University students that I absolutely respect is the passion and dedication to their research. Most of my lab members would spend half of their day, equivalent to 12 hours of researching, studying and working together in the lab. They are dedicated to the extent of sleeping in the lab at late nights when they are tired from work and resuming once they feel refreshed. Seeing all these great activities surrounding me, I have my absolute respect to the Japanese spirit when it comes to work.

Research and work aside, I have been exposed to the beautiful and astounding places Japan provides. Starting from Nagoya, I have been blessed with the opportunity to explore the Nagoya-ko Minato Matsuri, or the Port Festival. Crowds of people dressed in Yukata (authentic Japanese clothing) patiently waits for fireworks while sitting down with picnic mats covering their ground. The bright lights and echoing blasts from the fireworks still resound in me up to this date, and I would have never forgotten that experience. My group then traveled to Osaka, Nara and Kyoto to experience the modern side of Japan, as well as embracing her traditional aspects. It was a dream come true to be able to experience Japan at its best.

With these experiences, I am further enthusiastic in studying-abroad, experiencing different and unique cultures that satisfy my curiosity. This JUACEP program does not only enlighten me in my research program, but also it broadens my knowledge towards the understanding of the Japanese people. I hope that I would be able to explore other countries in the future, contribute my knowledge and effort to the research community, and at the same time enjoy the different cultures that the world provides. This program would not end my exploration in Japan; I would definitely be back again to enjoy and experience this amazing country all over again.

Syed Talha Wasif
MSE – Mechanical Engineering
University of Michigan, Ann Arbor

JASSO Scholarship Essay – JUACEP Summer Program 2012

My 2 months of association with Nagoya University has been an exciting, rich and well-rounded experience. During my stay, I worked on Uncertainty Quantification of Fission Product Inventories in Professor Yamamoto's lab at Nagoya University. Considering my coursework in computational methods at Michigan, I found my work at Nagoya University closely complementing my academic background. The fact that the research finds its direct application in planning the aftermath of Fukushima incident was a source of immense motivation for me.

An area that I initially faced difficulty with was that of nuclear engineering but I was able to learn the preliminary concepts most relevant to my research during the first couple of weeks at the lab. I would like to acknowledge the help extended by Professor Yamamoto, Professor Endo and the entire research team in this regard. In addition to the research project, I found the JUACEP Summer Program curriculum extremely conducive in exposing students to contemporary Japanese culture and latest technological developments in Japan.

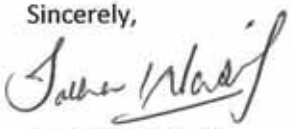
I found the intensive lecture modules particularly helpful to develop a sense of direction in which the Japanese industry is focused. Japan is globally considered to be a hub for technological expertise and I feel myself fortunate to be engaged in valuable exchange of ideas with Japanese industry experts through the JUACEP Summer Program 2012. In addition, the visits to Toyota Motors and Mitsubishi Motors manufacturing facilities were an extra-ordinary opportunity to witness engineering practices in Japan first-hand.

Despite the cutting-edge research and technological environment that I remained a part of, if I were to name the single biggest take-away from my stay in Japan, I would pick my experience of Japanese culture. Within these 2 months I got to visit many major cities in Japan including Tokyo, Osaka, Kyoto & Nara and I witnessed the rich history of the country that has shaped how modern day Japan looks. Basic knowledge of Japanese language that I learnt through Japanese language classes during my stay were instrumental in communicating with local people and experiencing the true spirit of Japan.

I believe this study-abroad program was a substantive and highly rewarding experience for me. It helped me grow on the learning curve by working and studying in an academic environment that is considerably different from the one I experienced in the United States. I have always valued the importance of exposure to cultural diversity in character-building and I believe my brief but rich experience in Japan will add immense value to my personal and professional profile. This was also my first formal experience of a study-abroad program; and it has strengthened my longing to participate in more such programs in different cultural settings. I believe these experiences will set me apart from my peers and give me a distinct competitive advantage in my future endeavors.

I would like to express my deepest gratitude to the entire JUACEP Team and Professor Yamamoto's Lab Group for hosting the program and making my stay in Japan memorable and meaningful. I would also like to thank Professor Kurabayashi at the University of Michigan for facilitating my participation in the program. I highly value the relations that I have developed in Japan through the program and I look forward to having a lasting association with Nagoya University.

Sincerely,



Syed Talha Wasif

Scholarship Report

The reason why I chose to come to Nagoya University in Japan is that I can pick up some basic and authentic Japanese. As everyone knows, Japan came across a big earthquake, which results in the shortage of power in Japan. However, it is this disaster that pushes the development of Japanese EV, PHEV, FCV, etc. And in the near future, Japan will dominate the market of EV, and Japanese cut-edge technique of EV will lead the whole world, possibly even better than that in USA. Moreover, personally, I believe EV currently is becoming more and more significant, since the traditional gasoline is being used up, and it is high time that new energy such as fuel cell, or electricity should be used for vehicles. Then learning some Japanese is helpful for me to further study Japanese EV technique.

Furthermore, the intensive lectures on EV, PHEV, FCV, CFRP, given by the working staff of some famous car companies like Toyota, Honda, Japanese Energy Department, are very excellent and helpful for my next semester study in University of Michigan.

In addition, the visits to Toyota and Mitsubishi vehicle companies are great. During the visit, I learnt some smart ideas of the vehicle assembling line, and I was impressed by the large-scale auto-production by many robots. What's more, I experienced the EV driving in Mitsubishi company. The driving was so quite and the vehicle was as fast as the

traditional gasoline powered vehicle.

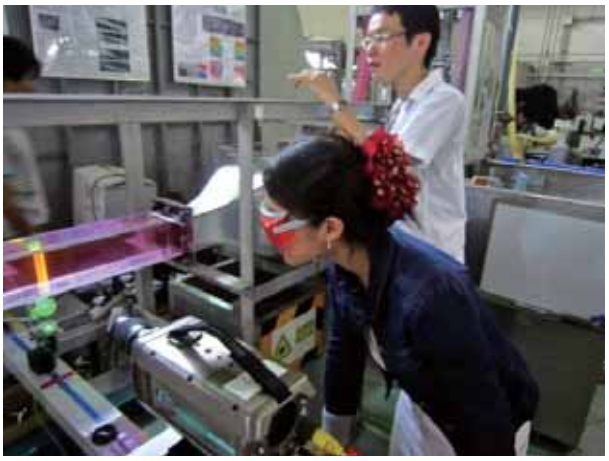
The research in the lab on crack healing helped me learn how to use some useful machines, such as SEM, High Electric Machine, Crack Introduction Machine, and so on. Besides, three presentations about my research in front of audience helped me hone my presentation skill.

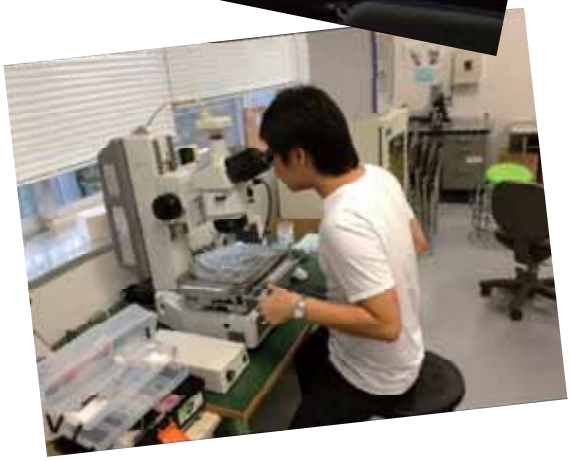
Additionally, I make many friendly Japanese friends, and learn a lot of Japanese culture. If next summer, we still have such chance to visit Japan, I will definitely choose to come here again. I am interested in Japanese language now, and after I go back to America, I will continue working hard on Japanese. I hope I am able to speak fluent Japanese by my next visit to Japan.

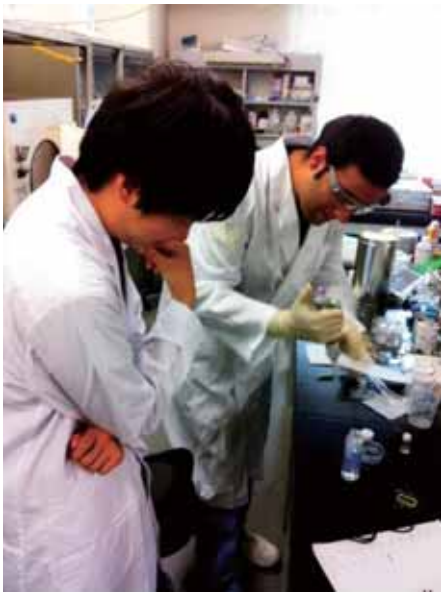
Yue Ning
宁宇

<4>
Appendix

4-a. Pictures

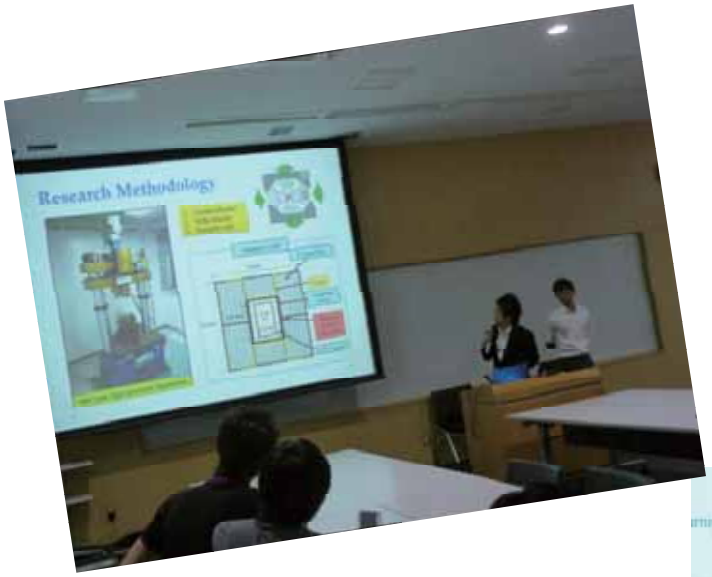




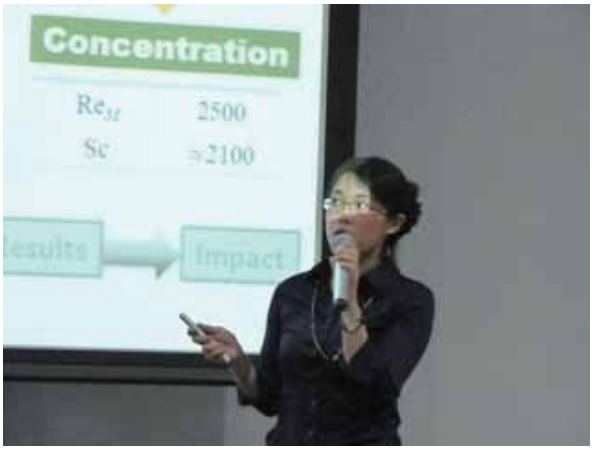


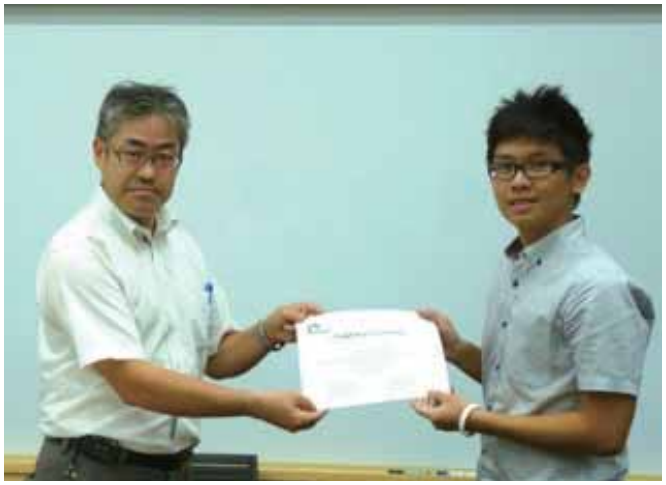

TOYOTA

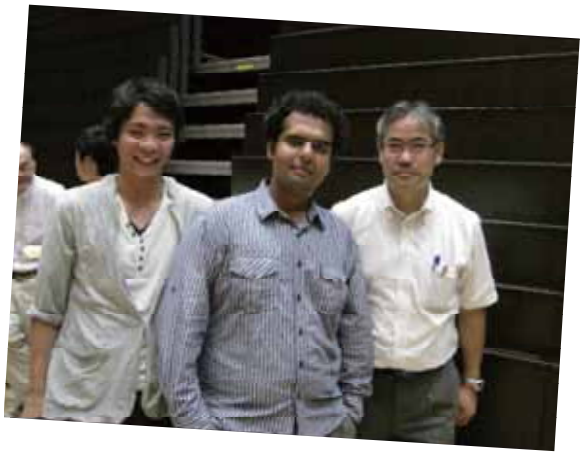

八月九日
九万九千功德日
當山

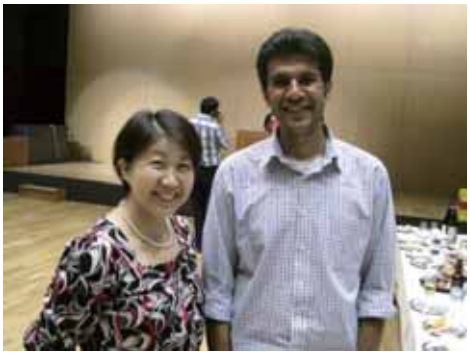

Research Methodology


Turning point


Concentration
Impact







4-b. Handout Materials

Orientation Agenda

JUACEP Summer Program 2012

Monday, July 2nd, 2012

10:00 [Room 032, ES Building]

Welcome from the program leader

Introduction of faculty, staff and Michigan students

Academic Information

A) Schedule

B) Intensive Lectures

C) Japanese Language Class –text book

D) Special Lectures by Prof. Kurabayashi (the University of Michigan)

E) Factory Visits –Toyota (7/27), Mitsubishi (8/2)

F) Excursion –Kyoto trip (8/3)

Life Information

A) Accommodation

B) Medical and Health Care

C) Refuse Disposal at Nagoya University

D) Transportation in Nagoya City

E) Submission of the JASSO Scholarship Report

F) Internet and Compliance of the Information Security Policy

-Pledge of Compliance of the Information Security Policy of Nagoya University

G) Student ID Card

11:30 Introduction of lab teachers

12:00 Welcome lunch @ Chez Jiroud

~Welcome from the dean of the department~

13:00 [Accounting Office]

Stipend, tuition fee, admission fee and health insurance

14:00 [Room 320, Eng.Building2]

Introduction to lab TAs

Housing

International Residence Higashiyama (Higashiyama Campus)

Address: 1 Furo-cho, Chhikusa-ku, Nagoya 464-0814, Japan

Tel: +81-(0)52-789-2197 (Office)

Facilities: This is an eight-story building with 95 single rooms for foreign students (17 ㎡) and 20 rooms (34 ㎡) for couples. It houses a lounge, a library, a meeting room, a Japanese style room, a laundry room, a cross-cultural room and an administrative office. Each room is furnished with a kitchen, bathroom with toilet, bed, wardrobe, closet, desk, chair, air conditioner, refrigerator, shoebox etc.

Five Japanese graduate students live in the Residence as tutors. Wireless LAN Internet connection is available in the Lobby on the 1st floor.

PC & ID

Use of PCs on Campus

Wireless internet connection is available on campus including the Satellite PC Lab in the main library, and other areas on campus. If you want to connect our lap top PC to Nagoya University Wireless Network (NUWNET), please go to 'ECIS computer web page' (http://eee.ecis.nagoya-u.ac.jp/computer/instr.html) After receiving your ID and password, you must take the online Information Security Training and pass the test within a week. To pass the test, you must score at least 80% and retake the test until your score 80& or above.

Student ID Card

A student ID card has many functions. It will let you into the university libraries, and with the card you may borrow books from the library. The card lets you get student discounts at museums, theatres and so on.

Medical and Health Care

1. Medical Services

If you suffer from continuous headaches, a loss of appetite, or you cannot sleep well, etc., you should seek the advice of a doctor before the condition gets worse. These symptoms may be a sign of fatigue or exhaustion. They may also be psychological or psychosomatic symptoms, which are treatable by specialist doctors. In addition to taking care of your own health, please pay attention to your friends' health and encourage them to see a doctor, if they are feeling unwell.

(1) The Health Administration Office Students can undergo physical examinations, receive health advice, first-aid and arrange psychiatric counseling at this facility. There is no charge for using any of these services.

Tel: 052-789-3970

[Office Hours for Health Services]

Treatment	Time	Mon	Tue	Wed	Thu	Fri
Physical Examinations & First-Aid	10:00 – 11:30	○	○	○	○	○
	13:30 – 16:30	○	○	○	○	○
Psychiatric Counseling	10:00 – 12:00	○	○	○	○	○
	13:30 – 16:30	○	○	–	○	○

*Note: Appointments are necessary for psychiatric counseling services. Please call the office 052-788-6276 for appointments.

The Health Administrative Office is open between 9:00 - 12:00, 13:00 - 17:00 for first aid.

(2) Calling an Ambulance

Telephone ll9 or press the RED button on a public phone for connection, free of charge.Although it is possible to speak English, it would probably be helpful for you to say the following: **Kyukyusha** (ambulance) **o onegai shimasu**.**Basho wa** (your location) **desu**.(I am calling for an ambulance.I am at...lo-cation.) This number is also used for requesting fire engines (**shobosha**).In Japan, ambulances are available 24 hours a day, free of charge.

2. Health Precautions

(1) Food Poisoning

Great care should be taken with regard to eating habits during the extreme summer weather in Japan. To avoid food spoilage, check the expiration date before buying food, apply heat to raw foods and be careful not to keep food in the refrigerator for an excessive amount of time. To guard against food poisoning, always wash culinary items with hot water. In the past, there was a frightening outbreak of O-157, a bacterial food poisoning disease. There was also an incident where students enrolled at Nagoya University were poisoned by eating wild mushrooms.

(2) Necessary measures to prevent the spread of infectious diseases

If you are traveling from Japan to another country, please seek travel advice regularly until the time of departure. Please follow the basic rules of hygiene to avoid being infected.

The Ministry of Foreign Affairs of japan: http://www.anzen.mofa.go.jp/

World Health organization: http://www.who.int/en/

Student Life

1. Refuse Disposal at Nagoya University

A sorting system for refuse disposal is used at Nagoya University. There are trash cans for “combustible refuse", “incombustible refuse", and recycle bins for “empty bottles", “empty cans", and “PET bottles" all

over campus. In addition, there are boxes and a reverse vending machine near the Co-op. The sorted refuse will be recycled. Newspapers or magazines are collected by recycle companies. Used paper products such as used copy paper are collected and recycled. Students are kindly requested to be mindful when they throw away their rubbish and to use the correct bins to help waste reduction and the reuse of recyclable materials.

2. Public Transportation

1. Subway and City Bus Tickets:

   ① Manaca: Manaca is a pre-paid pass that can be used for both subway trains and buses operated by Nagoya City. Various types of Manaca can be purchased. It can be used for Meitetsu buses and trains, Aonami lines, Yutorito lines and Toyohashi railroad. It is a reachargeable card.

   ② One-day ticket: One-day tickets allow for unlimited rides for one day. One-day tickets for all bus, subway, and bus & subway routes are available. Ticket, Donichi-Eco-Kippu, that can be used on Saturdays, Sundays, holidays and the 8th of every month can be also purchased.

   These tickets include a discounted admission fee for some tourist facilities in Nagoya city such as Nagoya Castle or the Tokugawa Museum.

   They can be purchased at any subway station. For further information, refer to the following website:

   http://www.kotsu.city.nagoya.jp/ (Japanese)
2. Useful Links:

   The following websites provide information on available transport services, time-tables, etc..

   HYPERDIA: http://www.hyperdia.com/en/

3. If involved in a traffic accident.

If you are involved in a traffic accident, remain calm and do the following:

1. If anyone is injured, dial 119 for an ambulance.
2. Move any dangerous including vehicles, off the road to prevent other accidents.
3. Report the accident immediately, even if it is small, to a nearby police station and obtain a report of the accident.
4. Write down the license plate number of the car concerned as well as the name, address and age of the driver, after requesting to see his/her driver's license.
5. If there are witnesses, write down their names, addresses and telephone numbers.
6. Make detailed notes of the accident and take photographs, if possible.
7. See a doctor, even if you think that you are all right, because sometimes symptoms can take time to occur.
8. Consult your insurance company as soon as possible.

4. Compliance with Japanese Law

During their stay in Japan, any student who commits a crime, misdemeanor or any other illegal act, will be subject to legal procedures according to Japanese Law. Nagoya University also takes strict disciplinary measures against students who commit crimes or misdemeanors, and may expels them from university.

(1) Prohibition of Narcotics

In Japan, the possession and sale, for personal use or otherwise, of all narcotics and any illegal substances are strictly prohibited. If offered, refuse them. If leaving Japan temporarily, never agree to look after a stranger's luggage at the airport.

(2) Drinking and Smoking Restrictions

In Japan, people aged under 20 are not allowed to drink or smoke. Smoking is not allowed in many places, including stations, public facilities and within the campus. Nagoya city has special zones where smoking on the street is banned. If found smoking there, you will be fined.

Driving a car, riding a motorcycle or bicycle after drinking any amount of alcohol is a serious offence in Japan, and can also cause accidents. Never drive after drinking. Those who accept a ride in a car that is driven by a drunk driver or those who offer alcohol to a driver are all subject to punishment under Japanese law.

(3) Others

Whilst inside a shop, removing product wrappers, price tags or putting products into pockets or bags before actually paying for them may be treated as an attempt to shoplift in Japan. Talking loudly on your mobile phone or chatting with friends in public places, such as on a train, can cause disturbance in Japan.

5. Safety Guide

Japan is not as safe as most people think. There is the risk of crime anywhere in the world, including Japan. This is what you can do avoid problems.

- Avoid going out alone at night and keep away from deserted places.
- Many bag-snatchings occur in Nagoya. Keep your handbag close when walking on the street.
- Do not answer phone calls from unknown numbers. Do not open the door to strangers, even if they claim that they are representing certain companies. Lock and chain the door of your apartment when you are at home.
- There are deserted or dark places on campus which you should avoid. There is the risk of theft inside and outside of buildings. Please always protect your property.

6. Culture shock

Although “culture shock” is generally understood as a temporary shock felt when confronted by different cultural customs, ways of thinking and behavior patterns, it actually refers to a psychological state of depression caused by a succession of failure experiences in unfamiliar social situations. Culture shock is temporary and everybody goes through it to some extent in the process of cultural adaptation. General symptoms of culture shock include negative feelings such as: losing self confidence, feeling depressed,

attributing all failure to yourself, feeling that nobody understands you, feeling inadequate, etc. Accordingly, you may lose all motivation to talk with Japanese people or to attend classes. Most of these psychological reactions are, again, very natural in the process of cultural adaptation. Please take time to cope with each single event in your life, and you will be able to overcome these emotions sooner or later.

7. Differences in "academic culture"

It is widely accepted that different values, behavioral and communication patterns exist from culture to culture. However, we often fail to realize that there are also differences in "academic culture", such as expected roles of academic advisers and students, classroom communication, evaluation criteria, etc. Such differences can also be a major cause of your stress. For example, the relationship between academic adviser and advisee is considered particularly important at the graduate level education in Japan. Some knowledge of the Japanese academic culture will help you achieve your goal more smoothly.

8. Cope with Stress

If you feel pressured by stress or lose confidence in your ability to study, you should think about releasing yourself from these negative emotions. Achieving good results in your studies may take a certain amount of time, and ought to be views as accumulative process. Sometimes, you will need to take a break. If you feel tired, do not push yourself too hard and try to enjoy some of your favorite foods, recreation, and phsical exercise. It is also recommended that you talk with your friends, academic adviser, or international students advisors/counselors. Moreover, please do not consider the process of cultural adaptation solely as a cause of stress; you can learn tremendously about various cultures, including your own, from this process.

< Visit the office of ECIS Advising & Counseling Services) >

If you feel that you cannot deal with stress or feel a sense of isolation or frustration, do not hesitate to ask for help from international counselors at the ECIS Advising & Counseling Services. There is an international student counselor who will support your personal and psychological concerns. A discussion with an international student counselor can help achieve a useful perspective on culture shock and insights into Japanese culture.

ECIS Advising & Counseling Services (7th floor, West Wing of IB Bldg.)

http://www.isa.provost.nagoya-u.ac.jp/en/

9. Harassment

Nagoya University has set up a Harrasment Consultation Center to prevent and eliminate the occurrence of any kinds of harassment, such as sexual harassment and academic harassment. Professional counselors deal with inquiries with utmost respect for their clients' feelings and wishes. Where the necessity arises, claims will be referred to the Committee for the Prevention of Harassment for investigation and arbitration. The Harassment Consultation Center works on issues of any degree of gravity. If you observe someone suffering from any kind of harassment, you may also come and report the case. In addition to the Harassment Consultation Center, each School at Nagoya University has appointed a faculty member as

contact person (cf. see below). For English language consultation, you may visit the representative at the Education Center for International Students (ECIS). All consultation will be kept strictly confidential.

Nagoya University Harassment Consultation Center (Appointments by fax or E-mail)

Tel: 052-789-5806 (9:30-16:00)

Fax: 052-789-5968

E-mail: sh-help@post.jimu.nagoya-u.ac.jp

URL: http://www.sh-help.provost.nagoya-u.ac.jp/Contact persons at each School (including ECIS)

URL: http://www.sh-help.provost.nagoya-u.ac.jp/pdf/madoguchi.pdf>

*Education Center for International Students (ECIS) & International Student Exchange Division (ISED). (2011). *Handbook for International Students.* Nagoya, Japan: Nagoya University.

Campus Map

Higashiyama Campus

Main Buildings

1 Administration Bureau Buildings
2 Toyoda Auditorium / Symposion
3 Nagoya University Museum
4 University Library (Central Library)
5 Noyori Conference Hall
6 Noyori Materials Science Laboratory
7 Akasaki Institute

Graduate School / School Buildings

8 Graduate School / School of Engineering Buildings
9 Engineering and Science Building (Central Building of Graduate School of Engineering / Particle and Astrophysical Science Building)
10 Graduate School / School of Science Buildings
11 Graduate School of Mathematics Building
12 Science and Agricultural Building
13 Graduate School of Bioagricultural Sciences / School of Agricultural Sciences Building
14 Environmental Studies Hall
-Graduate School of Environmental Studies
15 Graduate School / School of Economics Building
16 Graduate School / School of Law Building
17 Graduate School of International Development Building
18 Graduate School of Education and Human Development / School of Education Building
19 Integrated Research Building (Arts and Social Sciences)
20 Graduate School / School of Letters Building
21 Central Building for Liberal Arts and Sciences
-School of Informatics and Sciences Building
-Institute of Liberal Arts & Sciences
22 Building A for Liberal Arts and Sciences
23 Graduate School of Languages and Cultures Building
24 Graduate School of information Science Building

Centers / Institute Buildings

25 Center for Developmental Clinical Psychology and Psychiatry
26 Center for the Studies of Higher Education
27-1 Education Center for International Students
27-2 Advising & Counseling Services, ECIS
28 Center for Asian Legal Exchange
29 Information Technology Center
30 Kobayashi-Maskawa Institute for the Origin of Particles and the Universe (KMI)
31 Research Center for Materials Science
32 Bioscience and Biotechnology Center
33 Radioisotope Research Center
34 Research Institute of Environmental Medicine
35 Hydrospheric Atmospheric Research Center
36 Institute for Advanced Research Hall
37 Solar-Terrestrial Environment Laboratory
38 Eco Topia Science Institute
39 International Cooperation Center for Agricultural Education
40 Research Laboratory Building
41 Research Center of Health, Physical Fitness and Sports

Conference Halls & Galleries

(42) Noyori Conference Hall
(43) Noyori Materials Science Laboratory, Lecture Hall
(44) Engineering and Science Building, ES Auditorium
(45) Science South Building, Sakata & Hirata Hall
(46) Environmental Studies Hall, Lecture Hall
(47) Integrated Building (IB), Lecture Room
(48) Graduate School / School of Economics, Conference Hall
(49) Graduate School of International Development, Auditorium
(50) Integrated Research Building (Arts and Social Sciences), Conference Room

*International Plannning Division. (2012). *Nagoya University Handbook For Foreign Researchers.* Nagoya, Japan: Nagoya University.

LUNCH MAP

①Hokubu Shokudo / Cafeteria

②Shichimitei / Cafeteria

③Cafe Fronte / Coffee Shop

④Dining Forest / Cafeteria

⑤Restaurant Hananoki

⑥Rikei Shop / Convenience Store

⑦Craig's Cafe / Coffee Shop

⑧IB Cafe / Coffee Shop

⑨Shokuin Shokudo / Cafeteria

⑩Family Mart / Convenience Store

⑪Friendly Nanbu / Cafeteria

⑫Nanbu Shokudo / Cafeteria

⑬Hello Kid / Hamburger Steak Restaurant

LAWSON / Convenience Store

Bento Man / Lunchbox Shop

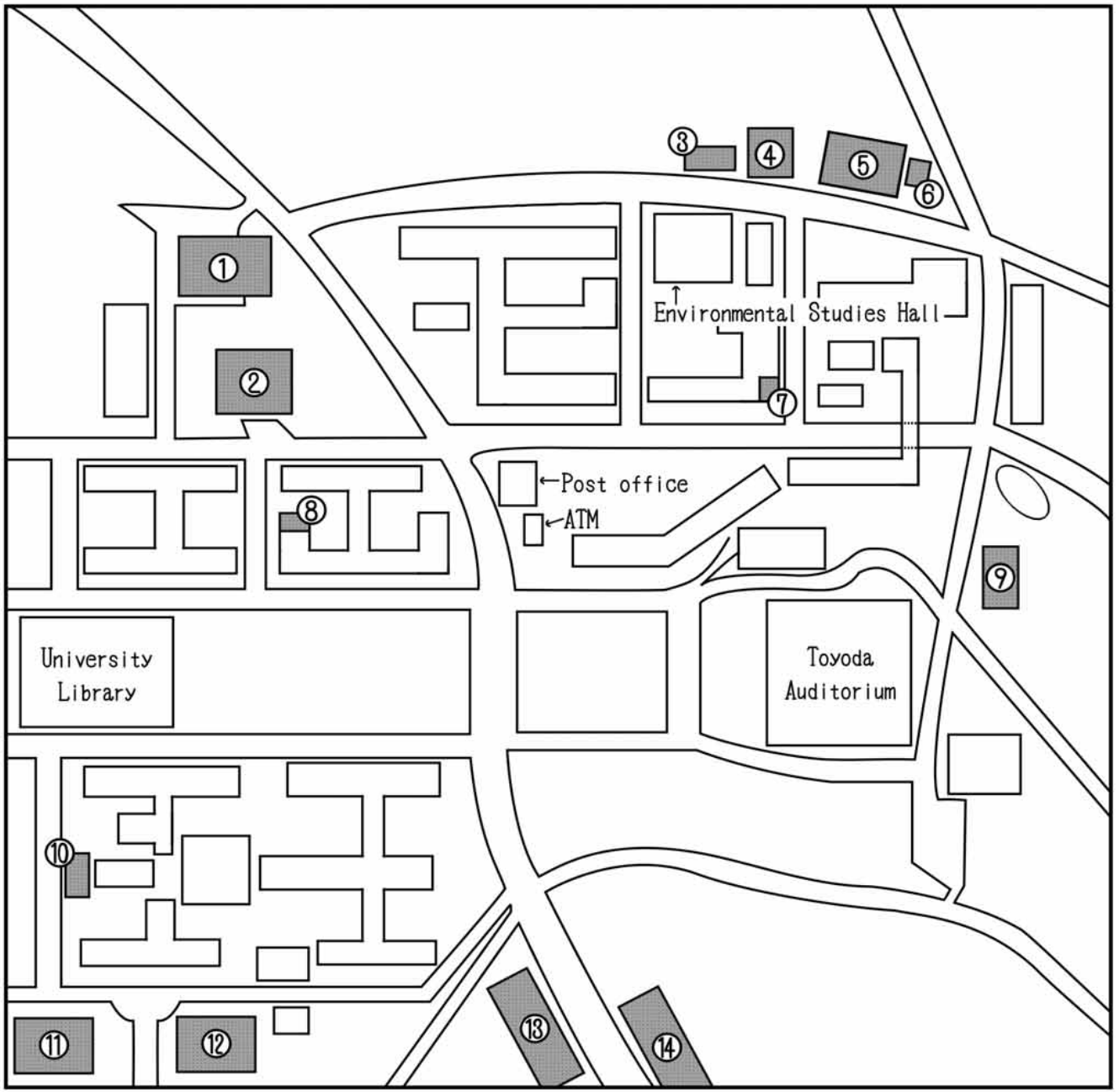
Botantei / Chinese Restaurant

⑭Cafe Terrace Cremes / Coffee Shop

Tsubovakitei / Grilled-meat (yakiniku) Restaurant

Kourantei

GRAN PIATTO / Italian Restaurant



*Education Center for International Students. (2005). *ECIS Nagoya University Education Center for International Students.* Retrieved June 8, 2012, from http://www.ecis.nagoya-u.ac.jp/en/info/life/clife.html

Hospitals around Nagoya University (※English OK)

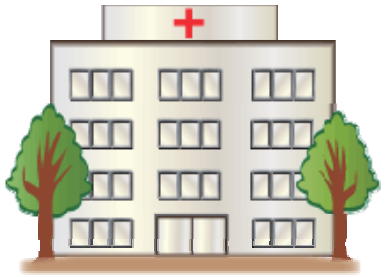
Nagoya Daini Red Cross Hospial
Address: 2-9 Myoken-cho, Showa-ku, Nagoya
Tel: (052) 832-1121
Mon-Fri: 8:00-11:00
Closed on Sat, Sun, holidays

Watanabe Clinic
Address: 1F Nikkou Yamate-dori Building, 3 -9-1 Yamate-dori, Showa-ku, Nagoya
Tel: (052)861-3450
Mon-Sat: 9:00-11:30
Mon, Wed-Fri: 16:00-17:30
Closed on Sun, holidays

Kai Clinic
Address: 32-2 Myoken-cho, Shouwa-ku, Nagoya
Tel: (052)836-9136
Mon-Sat: 9:00-12:00
Mon-Wed, Fri: 18:00-20:30
Closed on Sun, holidays

Yamate Dermatologist
Address: 2-9-1 Yamate-dori, Showa-ku, Nagoya
Tel: (052)836-4115
Mon, Tue, Thu-Sat: 9:30-12:30
Mon, Tue, Thu, Fri: 16:30-19:30
Sat: 14:30-17:30
Closed on Wed, Sun, holidays

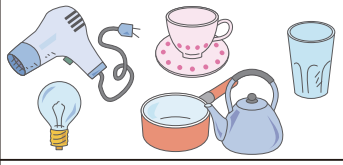
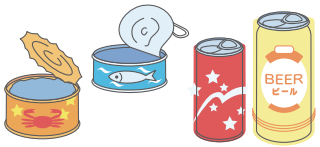
Fujimi Dentist
Address: 139 Yagotohujimi, Showa-ku, Nagoya
Tel: (052)835-3200
Mon-Wed, Fri, Sat: 9:30-12:30
Mon-Wed, Fri, Sat: 14:00-19:00
Closed on Thu, Sun, holidays



資源とごみの分け方・出し方一覧表

Sorting of Domestic Recyclable an Non-recyclable Refuse

Collection days are determined by neighborhood. Use this chart by circling the collection day in your area.

Collection	Sorting Category	Main Items (Examples)	Frequency	Collection Days (収集日を丸で囲ってお使いください)	Designated Bag
Usually Collected House-to-House	**Burnable Garbage**		Twice a Week	Mon. & Thu.(月・木) Tue. & Fri.(火・金) Collection on either Mon. and Thu. Or Tue. And Fri.	
	Hazardous Flammable Items	● Remove all lids.  Use up all the contents first. Punch holes in spray cans.		Mon. & Thu.(月・木) Tue. & Fri.(火・金) Collected on the same day as burnable items.	 ★
	Non-Burnable Garbage		Once a Month	First (第1) Mon. (月) Second (第2) Tue. (火) Third (第3) Wed. (水) Fourth (第4) Thu. (木) Fri. (金)	
	Large-Sized Garbage By Prior Request Fee required	 ● Large items exceeding 30 cm diagonally Call the Large Waste Service Center at least one week in advance of the collection day to request collection.	Once a Month	First (第1) Wed. (水) Second (第2) Thu. (木) Third (第3) Fri. (金) Fourth (第4)	Large Waste Service Center 0120-758-530 When calling by cell phone or from outside Aichi 052-950-2581 9 a.m. – 5 p.m. (excluding Sat./Sun./New Year's) *Service only available in Japanese.
	Plastic Containers and Packaging		Once a Week	Mon. (月) Tue. (火) Wed. (水) Thu. (木) Fri. (金) Confirm the day of the week on which collection occurs.	 ★
Collected at Collection Station	**Paper Containers and Packaging**		Once a Week	Mon. (月) Tue. (火) Wed. (水) Thu. (木) Fri. (金) Confirm the day of the week on which collection occurs. Sort by category before placing out for collection	 ★
	Recyclable Plastic Bottles PET	 ● Remove all bottle caps first. Bottle caps: sort with plastic containers and packaging. Be sure to crush plastic bottles first. Plastic bottles can also be recycled at convenience stores.			 ★
	Empty Glass Jars and Bottles Beverage Bottles Food Jars Makeup Vials	 ● Remove all bottle caps first. Plastic caps and lids: sort with plastic containers and packaging. Metal caps and lids: sort with non-burnable garbage.			Remove bottles from plastic bags. Place them directly in the blue bin.  Place bottles on sides when placing in the bin.
	Empty Cans Beverage Bottles Food Jars			Chikusa, Higashi, Kita, Nishi, Nakamura, Naka, Showa, Mizuho, Atsuta, Minami, Moriyama, Midori, Meito, and Tempaku Wards Nakagawa and Minato Wards — Place in the yellow bin.	 ★ 

名古屋市

★For the time being, any see-through transparent or semi-transparent bag may be used in place of designated recyclable garbage bags.

< Chinese version > http://www.city.nagoya.jp/zh/cmsfiles/contents/0000022/22540/guide_ch.pdf
< Hangul version > http://www.city.nagoya.jp/ko/cmsfiles/contents/0000022/22541/guide_ha.pdf