JUACEP Summer Training 2012 at University of Michigan

~August 1st - September 30th~

Japan-US Advanced Collaborative Education Program

Nagoya University

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Leaders of JUACEP
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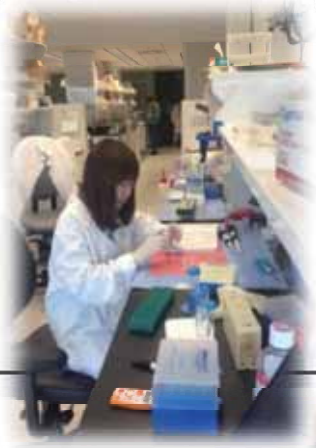
About the Program

1-a. Overview

This training program was designed for graduate students of Nagoya University to earn international experience. It provides an opportunity for them to meet and study together with students from all over the world at one of the top universities in the US. Each student stayed at UM laboratory and basically worked on their own master's thesis. They also participated in lab seminars and group discussions. The workshop was held at the end of the program to present the compilation of their achievement through the training.

Duration: August 1 – September 30

Aug.	1	Greeting to Advisors
	2	Research Training
		 
Sep.		
	27	Workshop

1-b. Participants

Students from Nagoya University

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Coordinator

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<2>
Research Training
&
Workshop

	Name	Advisor at Nagoya University	Advisor at University of Michigan
1	**Kenji Ishiguro**	Prof. Yoji Yamada	Prof. James Ashton-Miller
2	**Yuichi Iwase**	Prof. Yang Ju	Prof. Katsuo Kurabayashi
3	**Qiong Wu**	Prof. Yoshinobu Baba	Prof. Shuichi Takayama
4	**Keita Uchida**	Prof. Yang Ju	Prof. Jay Guo
5	**Misato Osuka**	Prof. Noritsugu Umehara	Prof. Albert J. Shih
6	**Nobuhide Otake**	Prof. Tsuyoshi Inoue	Prof. Gregory M. Hulbert
7	**Tohn Takahashi**	Prof. Tetsuo Iguchi	Assoc. Prof. Sara A. Pozzi
8	**Takahiro Nakashima**	Prof. Yang Ju	Asst. Prof. Jianping Fu
9	**Naoya Nakanishi**	Prof. Toshio Fukuda	Prof. Shuichi Takayama
10	**Yosuke Niimi**	Assoc. Prof. Mitsuhiro Shikida	Prof. Khalil Najafi
11	**Ryota Notsu**	Assoc. Prof. Hosei Nagano	Prof. Massoud Kaviany
12	**Mingrui Bai**	Prof. Hiroshi Yamashita	Assoc. Prof. Max Shtein
13	**Takuya Matsuyama**	Assoc. Prof. Mitsuhiro Shikida	Prof. Yogesh B. Gianchandani
14	**Takahito Yoshiura**	Assoc. Prof. Susumu Hara	Asst. Prof. Kenn Oldham
15	**Gen Li**	Prof. Eiji Shamoto	Prof. Jun Ni
16	**Yan Kuang Lim**	Prof. Noritsugu Umehara	Prof. Richard M. Laine

The 3rd JUACEP Workshop

Date: 13:00- 17:00, September 27, 2012

Venue: Room 1005, EECS Building, University of Michigan

~Presentation Title~

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Gen Li (P.85)

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Yan Kuang Lim (N/A)

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Naoya Nakanishi (P.90)

Relationship between two-phase separation and concentration

09.27.2012

Fiber optics for strain measurement in ACL injury

Presenter: Kenji Ishiguro

Department of Mechanical Science and Engineering,
Graduate school of Engineering,
Nagoya University, Nagoya, Japan

Topics
- **Knee injury experiment**
- **Strain measurement**

ACL injury epidemiology

More than 250,000 anterior cruciate ligament (ACL) injuries

- **80%･･･articular cartilage injury**
- **50%･･･meniscal tears**

ACL ruptures increase the risk for degenerative joint disease.

Figure. 1
Structure of a knee joint
from AOSSM SPORTS TIPS

Noncontact ACL injuries are most likely to occur when landing on a slightly flexed knee that is loaded by moments in 3 orthogonal planes.

1

U-M BRL hypotheses for ACL injury mechanism

An internal tibial rotation increased ACL strain more than an external tibial rotation.

ACL injuries occurred under both internal and external tibial rotation, combined with a knee valgus angulation.

The role of axial tibial rotation in ACL injury mechanisms has not drawn as much attention as that of the knee valgus loading.

It is not known which is the most common form of loading during ACL injury.

2

Experimental model

Objects:

To reveal which axial rotation increases an ACL strain most

- **a weight (W)**
- **the torsional transformer device (T)**
- **the bottom plate (P)**
- **6 degree of freedom load cell (L)**
- **quadriceps (Q)**
- **hamstrings (H)**
- **gastrocnemius (G)**
- **a miniature displacement transducer (ε)**

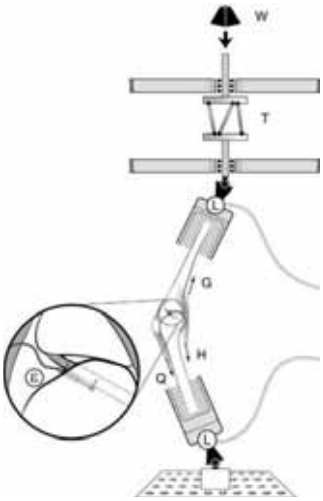

Figure. 2
Schematic diagram of the U-M test apparatus.
From Oh et al., AJSM 2012

3

Testing protocol

Table. 1
Repeated measures experiment protocol

Protocol	Loading Direction	Trials
BASE1	Compression + flexion moment	5
Internal tibial torque + knee varus moment*	Compression + flexion moment + internal tibial torque + varus moment	6
Internal tibial torque + knee valgus moment*	Compression + flexion moment + internal tibial torque + valgus moment	6
External tibial torque + knee varus moment*	Compression + flexion moment + external tibial torque + varus moment	6
External tibial torque + knee valgus moment*	Compression + flexion moment + external tibial torque + valgus moment	6
BASE2	Compression + flexion moment	6

From Oh et al., 2012

Preconditioning trials
↓
Base1
↓
A, B, C, D
↓
Base2

The height of the weight drop was determined during 5 preconditioning trials.

Base1 and Base2 had compression and flexion moment.

A,B,C,D had tibial torque and frontal plane moment in addition to Base condition.

40 trials were completed for each specimen.

4

Results

The strain under the internal tibial torque was 192% greater than that under external tibial torque.

Frontal plane moments did not significantly affect peak ACL strain.

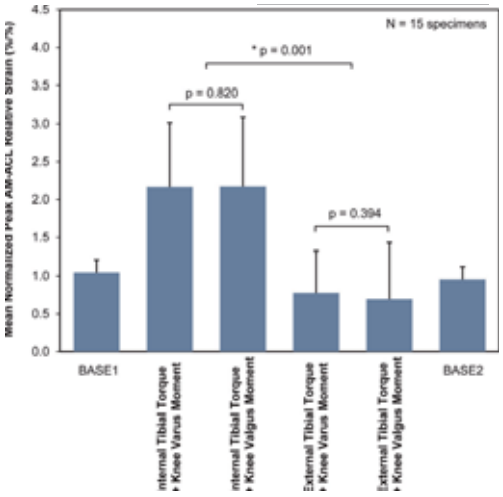

Figure. 3
Mean (SD, represented by error bars) normalized peak AM-ACL relative strain values under each loading condition.
Results from Oh et al. (2012)

5

Discussion

- The peak strain was most sensitive to the direction of axial tibial torque but less sensitive to the direction of the frontal plane moment.

- The peak strain under the internal tibial torque was significantly greater than corresponding values under the external tibial torque.

However, the method for measuring ACL strain has a limitation….

6

Strain measurement

DVRT barbs makes holes in ACL.

⬇

These holes cause stress concentrations that could initiate premature ACL failure.

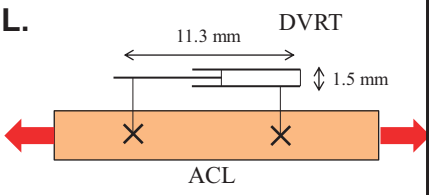

Figure. 4
Strain measurement with DVRT

We need a contact free method.

- Digital image correlation method (DICM)

⬇

We do not have enough space to use this method.

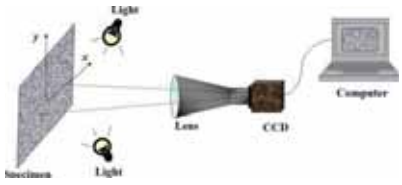

Figure. 5
Schematic diagram of DCIM

7

Fiber optics

Principle :

Calculate strain from the change in distance between grid lines

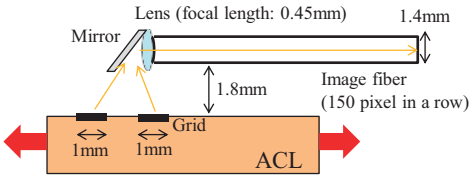

Figure. 6
Schematic diagram of fiber optics

Imaging fiber small enough to insert into the joint beside the ACL in the experiment

Table. 2
Pros and cons of DVRT and fiber optics

	DVRT	Fiber optics
Pros.	・Compact ・High resolution (1.5μm) ・High frequency response (2kHz)	・Compact ・High Resolution (20μm) ・Contactless type
Cons.	・Making holes in ACL	・Difficulty in tracing the grids

8

Conclusions

It is feasible to use fiber optics to measure ACL strain using a contact free method.

If so, it would improve our understanding of ACL behavior under repeated loading by circumventing the stress raisers caused by the DVRT.

But, it may be difficult to use fiber optics to track the grid lines at the high strain rates used during simulated impact landings.

So, further research is needed on the feasibility of fiber optics in this manner.

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Joule heating analysis using the COMSOL multiphysics software

Material Characterization & Mechanics Laboratory
Nagoya University
Yuichi Iwase

Background

I am involved in research on fatigue crack healing

Fatigue crack healing

We are trying to heal the fatigue crack in the metal material by applying an electric current

- By applying the current, a high density electric current field is localized at the crack tip
- Thermal compression stress at the crack tip is induced

the fatigue crack is closed

Before the electropulsing

After the electropulsing

[1] Hosoi A, Nagohama T, Ju Y. Fatigue crack healing by a controlled high density electric current field. *Mater Sci Eng A* 2012; **533**:38-42

1

Objective

Temperature and the electric current density are thought to be very important for thermal compression stress and atomic diffusion, which cause the healing effect

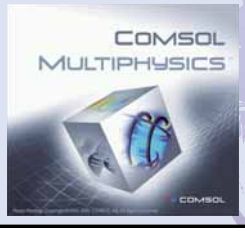
Problem

- It is difficult to exactly measure the temperature change due to joule heating because the duration of the current is very short
- The current density distribution and the rate of the current concentration can not be measured either

Temperature and current density can be beneficial for the further research in the mechanism of fatigue crack healing by using those values as the evaluation index of fatigue crack healing

Objective

To calculate the temperature and current density field by using COMSOL's joule heating physics module



2

Simulation conditions : investigated object

Material & Shape

Specimen : Austenitic stainless steel
Dumbbell type with the notch of 2mm length
Electrode : Copper / column with a diameter of 5 mm

Application

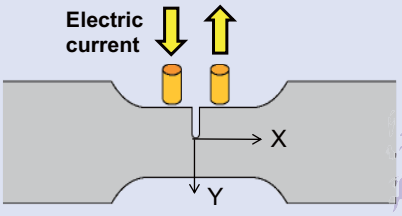
- Place the electrodes in contact with the specimen so as to straddle the notch
- Apply an electric current from one electrode to the other one

Applied current

100, 200, 300, 400 [A/mm^2]

Current duration

0.5 [ms]



< Schematic of investigated object >

3

Simulation conditions : Parameter and Mesh

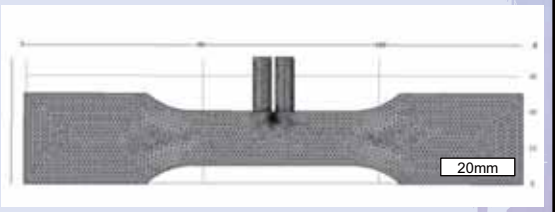
Material parameter

Material parameters were set as functions of temperature

Parameter	Unit	Equation
Density	kg/m^3	$7980-0.5T$
Specific heat capacity	$J/kg{\cdot}K$	$590-3\times 10^{-5}T+0.2T$
Thermal conductivity	$W/m{\cdot}K$	$16.7+0.148T$
Electrical resistivity	$\Omega{\cdot}m$	$(74+0.09T-3\times 10^{-5}T^2)\times 10^{-8}$

Mesh

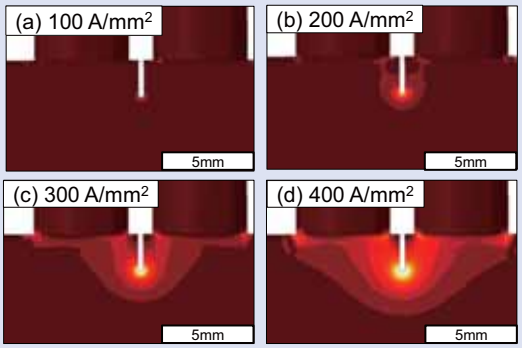
- Using tetrahedral mesh
- Number of element : 92,552



< Meshed model used in this simulation>

4

Simulation result : Temperature distribution



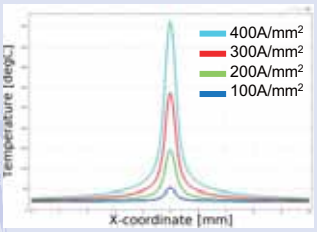
< Temperature distribution at different conditions >

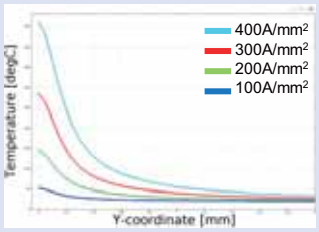
- It is found that the local high temperature area occurred around the notch tip

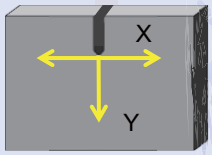
When an electric current was applied, the electric current flows through the shortest way and surpasses the notch tip. Therefore, the high density electric current field is formed around the notch tip.

5

Simulation result : Numerical result







< Temperature distribution along X-coordinate and Y-coordinate >

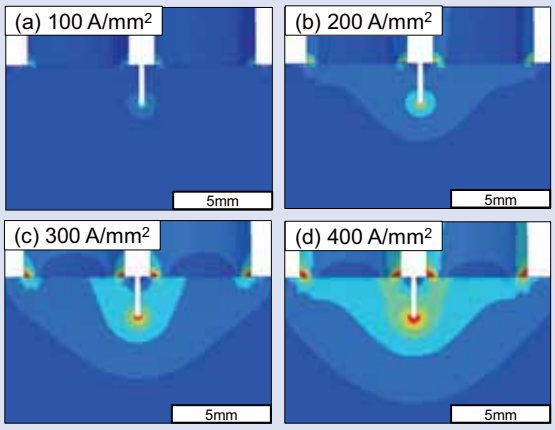
< Maximum temperature change >

Applied current [A/mm²]	Maximum temperature [℃]
100	53
200	146
300	286
400	462

- The significant change of temperature at the notch tip was observed
- The maximum temperature which increases with the increase of the applied current was obtained

6

Simulation result : Current density distribution



< Current density distribution at different current conditions >

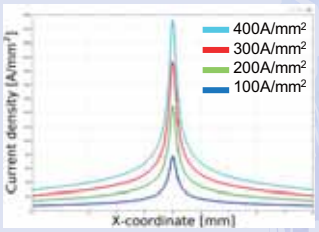
- Like the result of temperature, it is found that the high current density area was localized around the notch tip

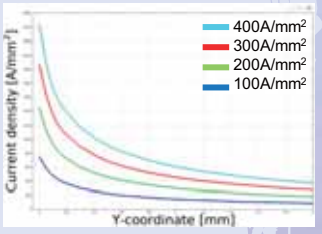
7

Simulation result : Numerical result

< the maximum electric current density >

Applied current [A/mm^2]	Maximum electric current density [A/mm^2]	Ratio of Max. current to applied current
100	749	7.49
200	1444	7.22
300	2068	6.89
400	2640	6.60





- Maximum electric current density is about 7 times as big as the applied value
- The ratio of max current to applied current became lower with the increase of the applied value

The reason is that the diffusion of the electric current to neighboring matrices increases with the increase in applied value

8

Conclusion

- The temperature field and the electric current density field were calculated by using COMSOL's joule heating physics module
- The local high temperature and high electric current density areas were observed around the notch tip
- I think that these simulation results can become beneficial for future experimental research

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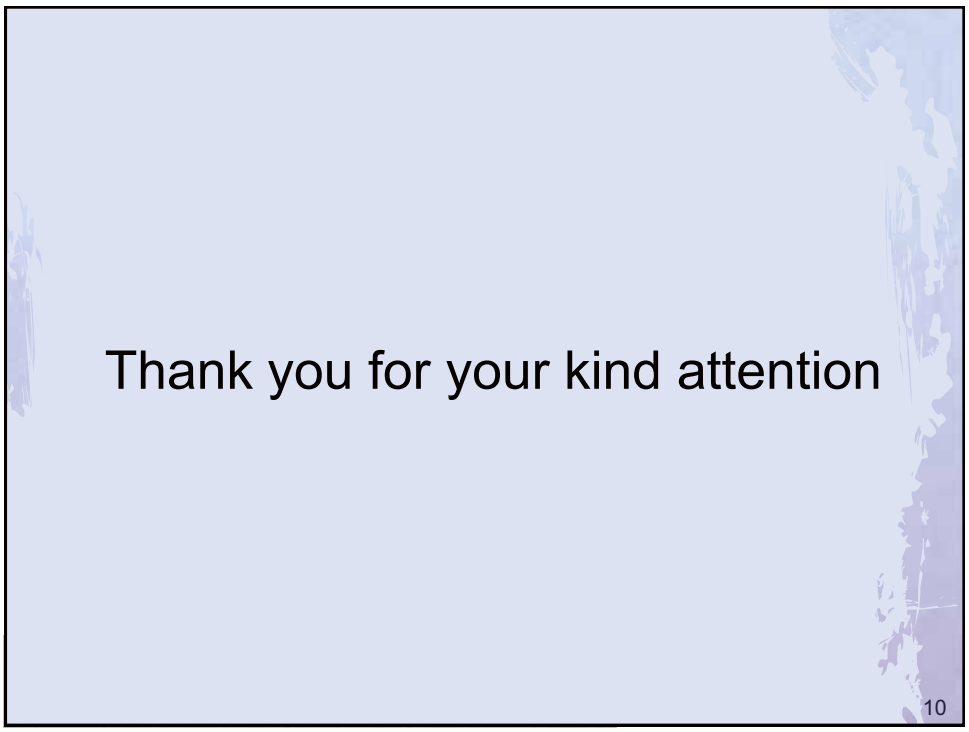

Thank you for your kind attention
10

Development of Arrays of Closed, Adjustable, and Reversible Nanochannels by Tunnel Cracking

Department of Applied Chemistry, Graduate School of Engineering, Nagoya University, Japan

M1 Qiong Wu
9/27/2012

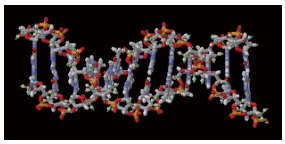
Introduction

Shuichi Takayama,
Professor, Biomedical Engineering
Professor, Macromolecular Science and Engineering

Better models of the body → Drug discovery; The mechanisms of disease; Clinical treatments

The Micro/Nano/Molecular Biotechnology Lab uses engineering expertise to assist life scientists in the study, diagnosis, and treatment of human disease. By developing better models of the body, they help advance drug discovery, increase understanding of the mechanisms of disease, and develop clinical treatments.

Background



DNA sequencing

Buleprint of human

Gene related to the disease

Early treatment & early diagnosis

DNA sequencer

Existing DNA sequencer

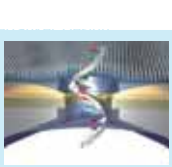
DNA amplification by PCR ⟶ Fluorescent label ⟶ Separating DNA ⟶ reading DNA sequencing

2 weeks

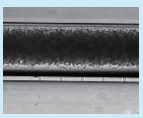
Background

Nanopore Sequencer

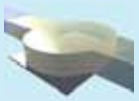
few hours



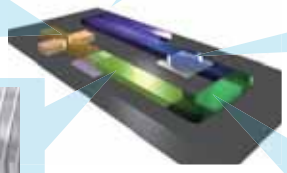
Sequencing of a single molecule



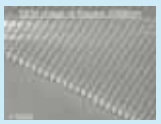
Separation of cell contains genome



Extraction of genome DNA



Extension and Fragmentation of a single molecule



Separation of DNA molecules

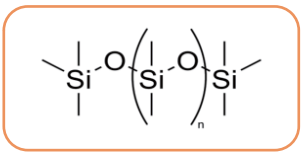
Disadvantages

- Fabrication is complicated
- Cost a lot of money

New Method

A New Method to Decode DNA Sequencing

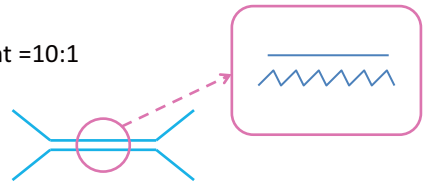
PDMS (polydimethylsiloxane)



I will present a new method to produce size-adjustable nanochannels in an even more direct and simple fashion. This approach is based on the mechanics associated with the tunnel cracking of a stiff, brittle layer sandwiched between compliant, tough substrates subjected to an applied tension.

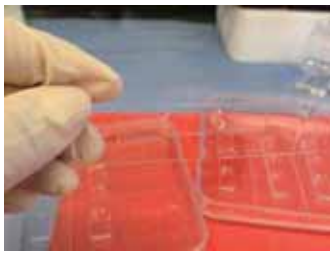
Fabrication of PDMS Device

- PDMS: Silicone Elastomer Curing Agent =10:1
- Cured at 60 ℃ for 12 hours
- Drilled reservoirs
- Plasma treatment : 7.5 min, 200W



width = 100 μm, height = 50 μm

Number of sawtooth : 400



How Nanochannels were created?

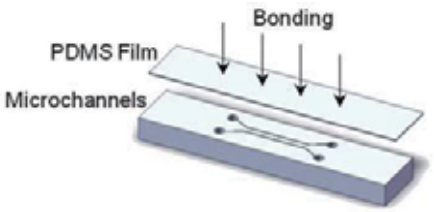


Fig.1 A patterned PDMS substrate and a featureless film of PDMS were exposed to plasma oxygen and bonded together.

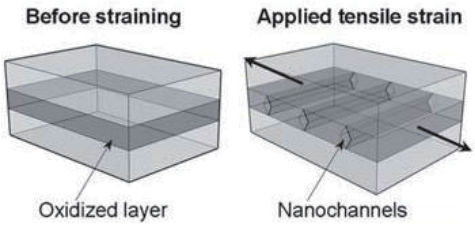


Fig.2 Nanochannels (tunnel cracks) connecting the two microchannel reservoirs were created within the bonded oxidized layer in response to a tensile strain.

How Nanochannels were created?

The first cracks were observed when the applied strain reached about 5%.

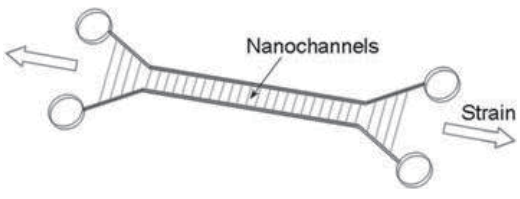


Fig.3 Nanochannels (tunnel cracks) connecting the two microchannel reservoirs were created within the bonded oxidized layer in response to a tensile strain.

Results and Discussion

Strain: 10% Speed: 5s

Number of sawtooth : 400

Cracking ratio	No.1	No.2	No.3
None	12%	6.4%	13.9%
One	46.7%	41.5%	41.6%
Two or more	41.3%	52.1%	44.6%

Strain: 10% Speed: 0.5s

Cracking ratio	No.1	No.2	No.3
None	23.2%	15.6%	4.1%
One	54.5%	53.3%	59.8%
Two or more	22.2%	31.1%	36.1%

High speed is better for obtaining a nanochannel at each sawtooth.

Conclusion

The fracture properties of a brittle sandwich layer in an elastomer → Nanochannels that open and close reversibly upon the application of a tensile strain

Advantages

- More direct and simple
- Low cost
- No need of electric power
- Can closed and open reversibly

Problems

- The location of nanochannels is not controlled correctly
- The width of every nanochannel is different

Elongation of DNA molecule is possible with this method.

Vertical Cu nanowire array on flexible base

Guo research group

Keita Uchida

Introduction

In Nagoya University, my research field is high density vertical nanowire arrays.

It is used as a new electrical and mechanical bonding method with two nanowire arrays.

This connection technique could replace current electrical bonding methods.

At U of M, Guo research group is conducting research in micro- and nano photonics, and nanomanufacturing process areas. The group members have advanced knowledge of nanostructures, and significant experience producing nanostructures on flexible substrates.

My goal is to produce high density vertical Cu nanowire arrays on flexible substrates to be applied to various locations

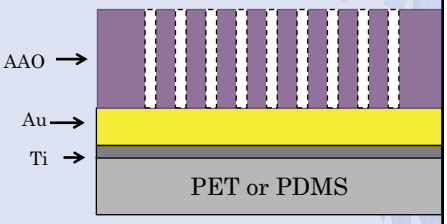
Method

Sputtering Ti and Au on flexible base

Put on Anodized aluminum oxide(AAO)

The AAO pores are filled with Cu through electrochemical deposition

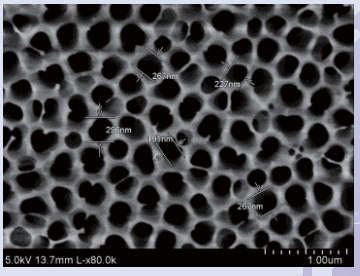
Remove the AAO



Cross Section

PDMS base

PET base



AAO SEM image

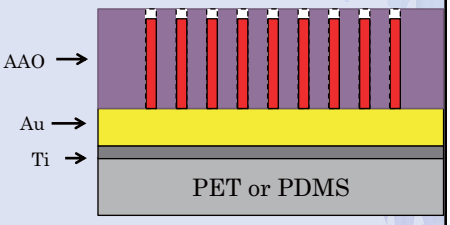
Method

Sputtering Ti/Au on flexible base

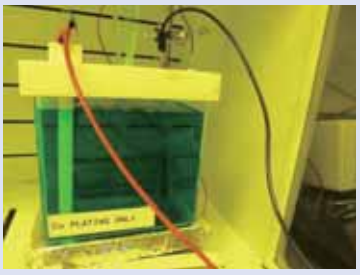
Put on Anodized aluminum oxide(AAO)

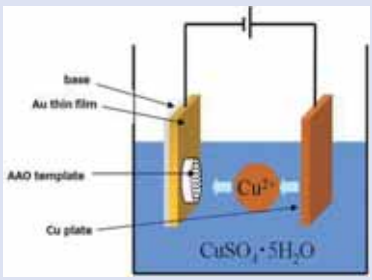
The AAO pores are filled with Cu through electrochemical deposition

Remove the AAO



Cross Section





Electrochemical Deposition

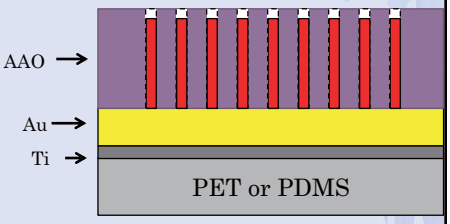
Method

Sputtering Ti/Au on flexible base

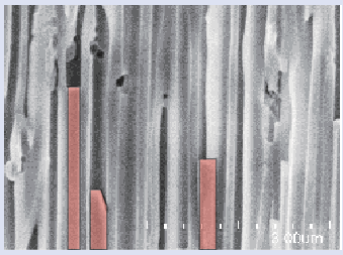
Put on Anodized aluminum oxide(AAO)

The AAO pores are filled with Cu through electrochemical deposition

Remove the AAO



Cross Section



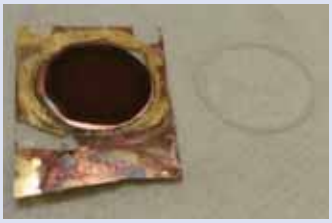
SEM image of AAO cross section

AAO etching

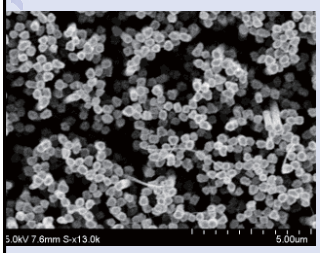
Result

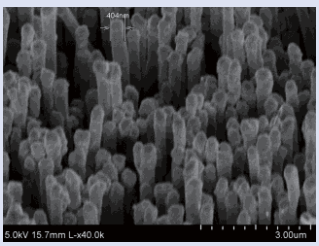
Sample 1: PET base, iD=6.4mA/cm^2, t=3h2min , KOH etching

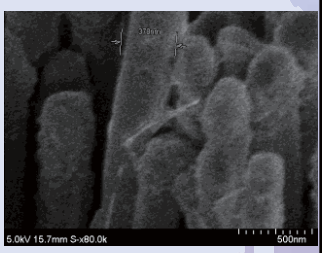
Post Plating



Post AAO Etching wit KOH ~8min







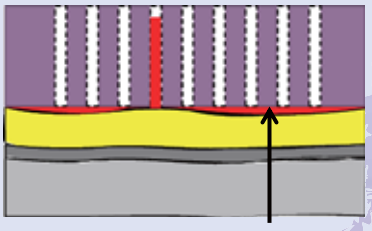
Result

Sample 2: PDMS base ,iD=6.4mA/cm², t=3h40min, NaOH etching

Post Plating

Post AAO Etching wit NaOH ~8min

The AAO is peeling from base

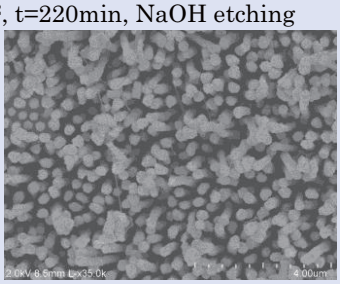


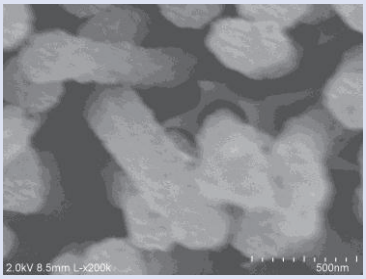
Doesn't filled AAO pores well because Cu filled this space.

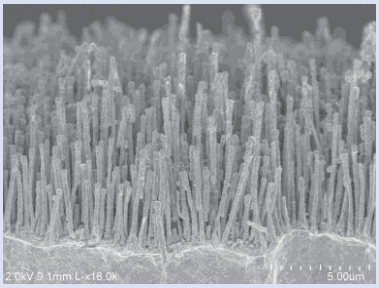
Result

Sample 2: PDMS base ,iD=6.4mA/cm², t=220min, NaOH etching

Good contact in this area





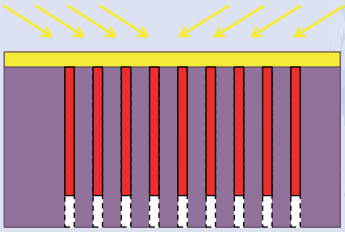


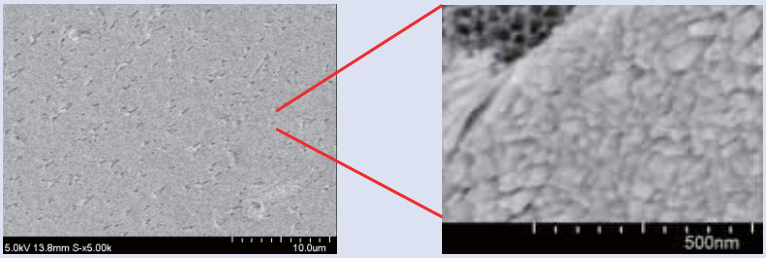
method

Angled sputtering of Au to plug/cover the top of AAO pores

The AAO pores are filled with Cu through electrochemical deposition

Remove the AAO



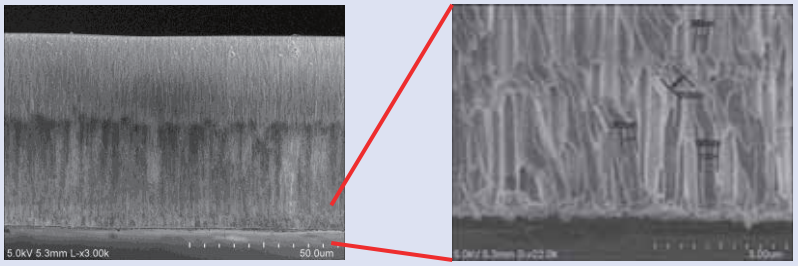


Result

Sample 3:iD=6.4mA/cm^2, t=4h16min, NaOH etching

Post Plating

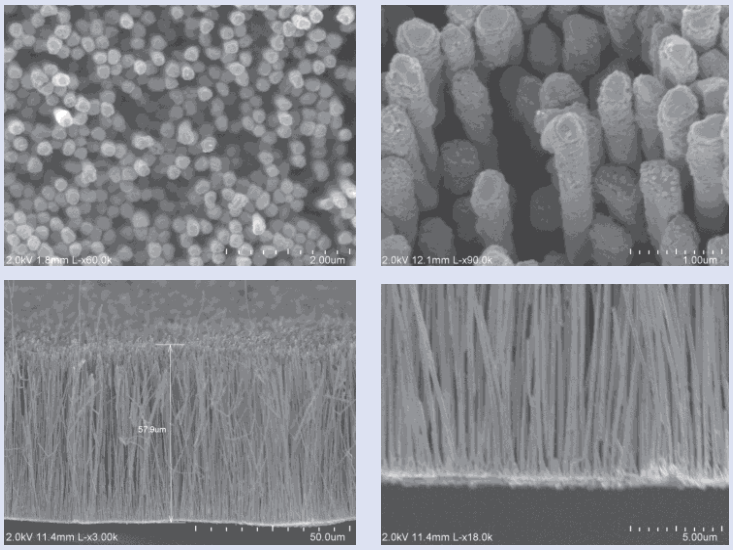
Post AAO Etching wit NaOH ~20min



Cross section post plating

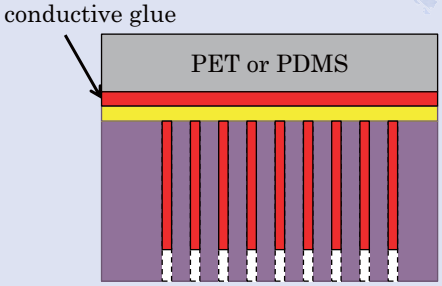
Result

Sample 3:iD=6.4mA/cm^2, t=256min, NaOH etching

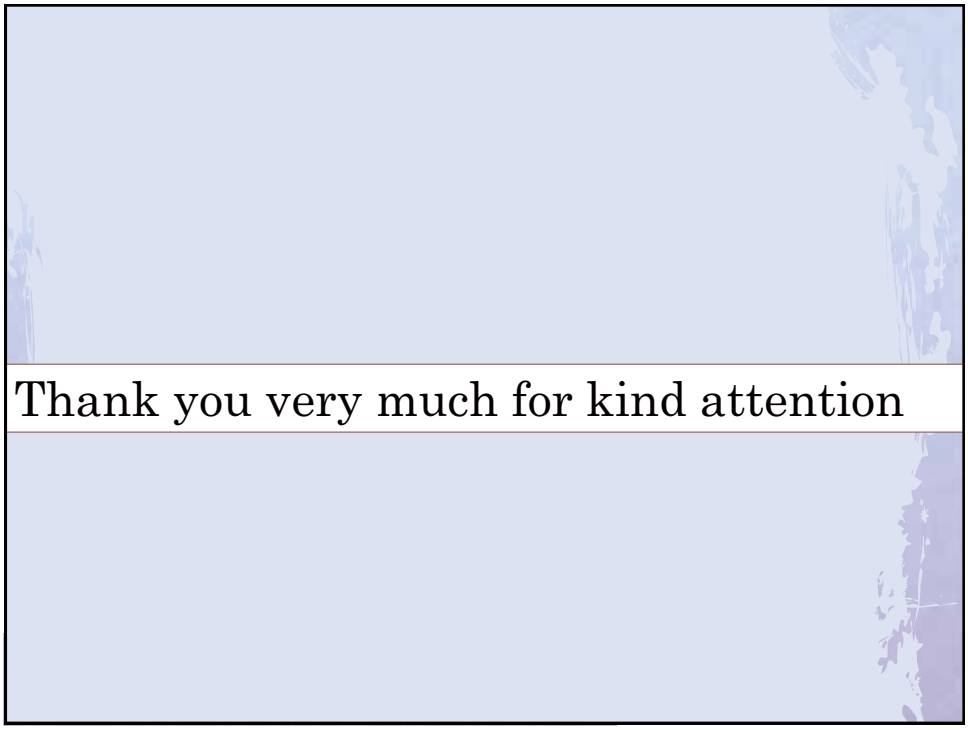


Future work

Connecting flexible base and AAO filled with Cu by using conductive glue
After that, remove the AAO



Bonding two nanowire arrays and examine the performance of connection, such as electrical resistance and mechanical strength


Thank you very much for kind attention

Development of Monopolar to Reduce Adhesion of Blood Coagulation

Advanced Materials and Manufacturing Laboratory
Department of Mechanical Science and Engineering,
Nagoya University

Misato Osuka

Director : Prof. Umehara

Background

Monopolar

- Surgical knife using AC
- Used in over half of operation

Advantage

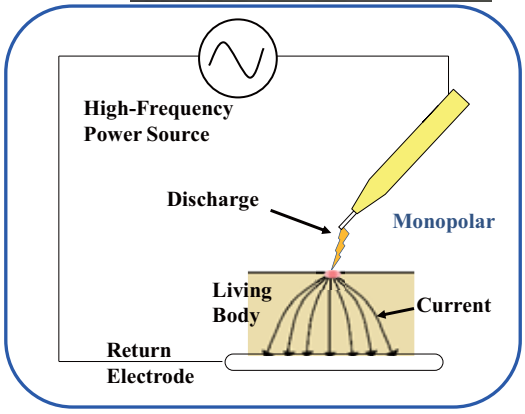
1. Simple mechanism
2. Easy to use and master
3. Able simultaneously to cut and stop bleeding

Principle

Discharge current concentrate on tiny area

→ Joule Heat

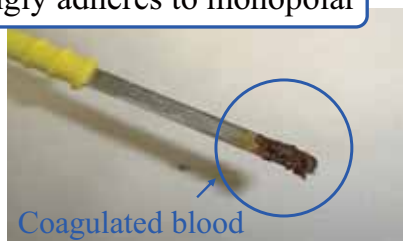
Incision and coagulation



Motivation

Problem Coagulated blood strongly adheres to monopolar

- Discharge can't occur and lose ability to cut
- Bleeding occurs again by separating knife from tissues

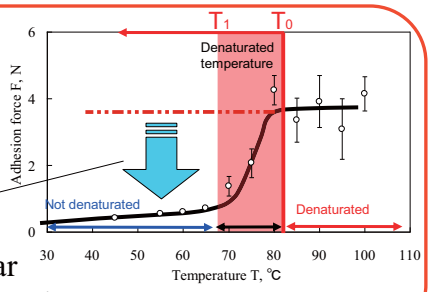


Solution

To reduce the adhesion of blood coagulation

Need to keep the surface temperature of monopolar under the threshold of protein denaturation.

Force Down

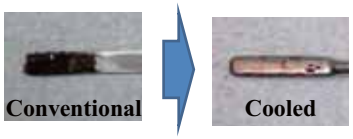


Referrence: Y Nakashima,et al.(2012).

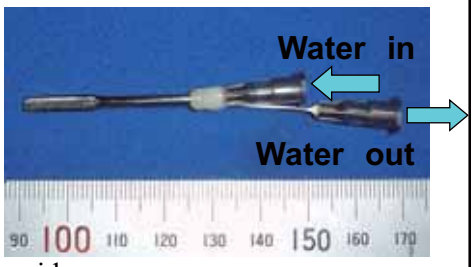
Motivation

Under T_1=65℃ on the knife tip,
it was succeeded in preventing adhesion of blood coagulation by water cooling system

Referrence: Y Nakashima,et al.(2012).



Bulky water tube might disturb surgical operation



Peltier Device

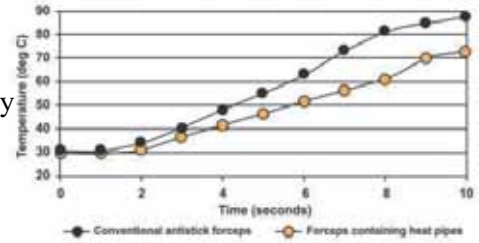
Semiconductor device
Transport heat from one side to the other side.
Give temperature difference between both sides.

- Not required thick tube (just need thin electric wire)
- Possible to downsize
- Possible to adjust endothermic power

Reference about Heat Pipe

IsoCool bipolar forceps (Codman & Shurtleff,Inc)

The device uses **heat pipes** within the shafts of the bipolar to continuously transfer excess heat away



Heat Pipe

Using the phase-change of condensation and evaporation of the liquid actuation which is sealed in pipe

- High thermal efficiency (several hundred times as high as Cu)
- Fast thermal response
- Lightweight

Reference: Ebonia W. Elliott-Lewis, 2009

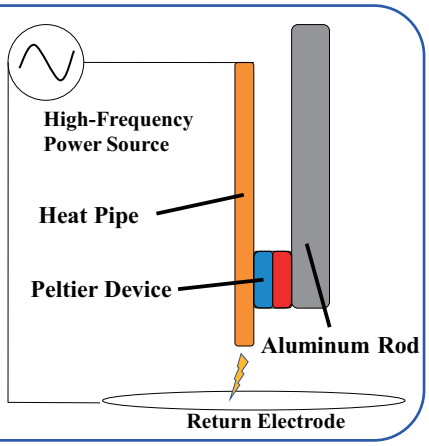
Fabrication

Objective

To prevent rapid temperature rise with heat pipe cooled forcibly with Peltier device

Fabrication

- Impossible to cool tip of knife directly
- Need to attach Peltier device far from tip of knife because of ensuring visibilty.
- Need to remove heat from hot side of Peltier device.



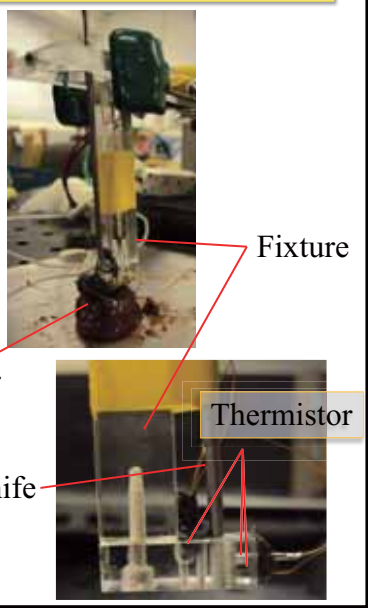
Method

Measure surface temperature of knife tip and tissue during discharge.

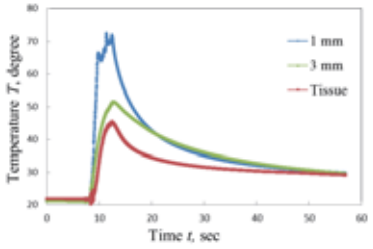
1) Stainless Steel Rod (2 mm diameter)
2) Heat Pipe (2 mm diameter)
3) Heat Pipe + Peltier Device

Measurement Point
from Knife End ; Tip 1 mm
3 mm
Tissue 1 mm

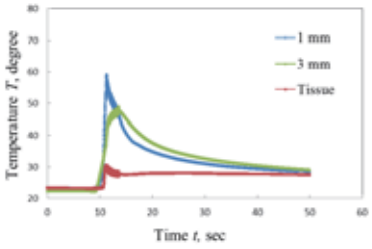
Target ; Bovine Liver
Radio Knife Power ; 25 W
Measurement Device ; Thermistor



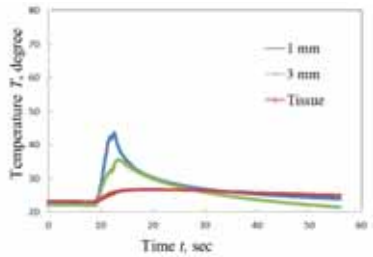
Results



Stainless Steel Rod



Heat Pipe



Heat Pipe + Peltier Device

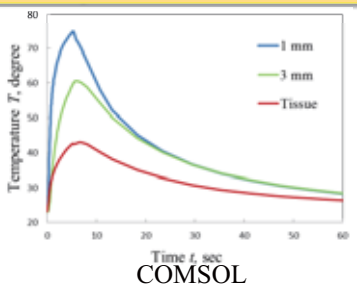
Discussion

"Heat Pipe" specimen even reduced temperature rise

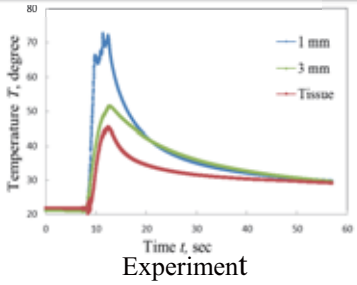
"Heat Pipe + Peltier Device" specimen works best
Kept temeprature of knife tip under 45 degC
Possible to keep temperature under the threshold of protein denaturation

Simulation with Stainless Steel Rod

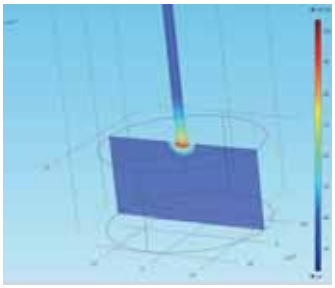
A multi-physics finite element model (FEM) with COMSOL to simulate the temperature field of Stainless Steel Rod specimen



COMSOL



Experiment

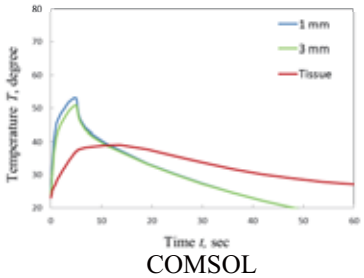


Discussion

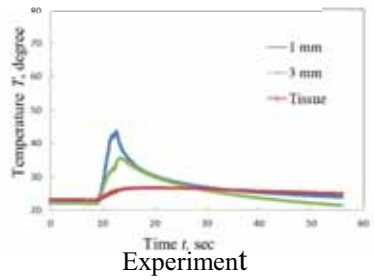
Although the temperature curves after discharge are a little different, COMSOL made almost perfect model.
The hottest temperature is 103.42 degC.

Simulation with Heat Pipe and Peltier Device

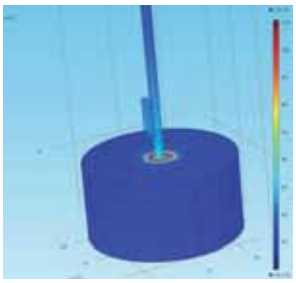
A multi-physics finite element model (FEM) with COMSOL to simulate the temperature field of Heat Pipe and Peltier Device specimen



COMSOL



Experiment



Discussion

This model does not work well.
All lines are higher than ones of experiment.
It might be due to wrong setting of heat pipe.

Conclusions and Future Works

Conclusions

Heat Pipe and Peltier Device specimen
Succeeded in decreasing the maximum temperature.
Possible to keep the temperature under the threshold of protein denaturation.

The FEM of Stainless Steel Rod specimen
Possible to accurately predict surface temperature field of.

Future Works

Simulate perfect temperature field of Heat Pipe and Pelier Device specimen by using FEM with COMOSOL.
Simulate the hottest temperature.
Check whether it is under the threshold of protein denaturation.
Find out the best condition.

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Evaluation of a New Biopolar Coagulation Forceps in a thermal Damage Assessment.
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Thank you!

Computational time reduction method in FEM analysis

Nobuhide Otake

Outline

1.Background and Objectives

2.FEM model and Equation of motion

3.Time reduction method with banded matrix

4.Simulation of the eigenvalue analysis

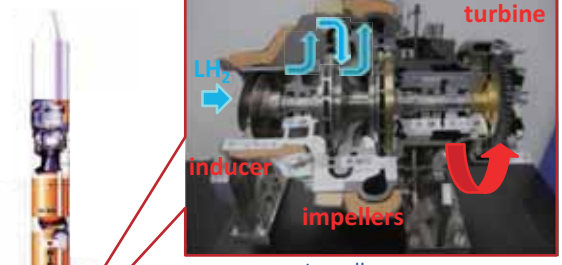
5.Conclusion

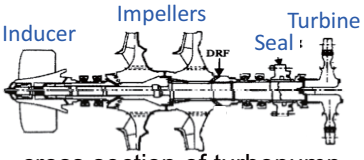
Background

What is turbopump? High speed rotating machinery in rocket engine

Role of turbopump •make the pressure of the liquid fuel in impellers high
•supply it to combustor

H Ⅱ A rocket





cross section of turbopump

need
・smaller size
・higher power

⇩

・rotates at a speed as high as 42000rpm
・supply liquid fuel as much as four barrels per second

Causes vibration and rotordynamic fluid force

Objective

Combustion test

The most important problem is large vibration in turbopump system.

To improve performance and reliability of engine system

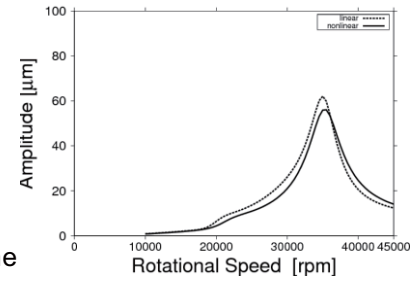
It is important to create a method that can accurately analyze the vibration in dynamic state.

This study

Simulation of the frequency response takes about 7 hours.

⇨ It is inconvenient to do case study.

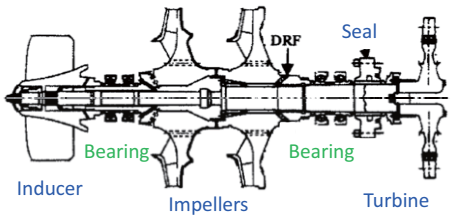
⇩ to reduce computational time

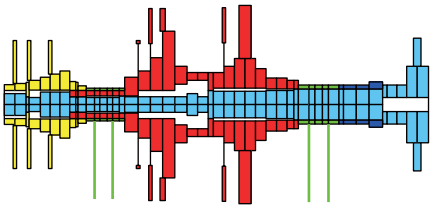


make efficient program by using property of banded matrix

FEM model of turbopump system

cross section of turbopump





FEM model

・discretization in axial direction

・most of elements are modeled by beams

Number of all elements	98
Number of all nodes	104
Number of degrees of freedom	416

4

Equation of motion

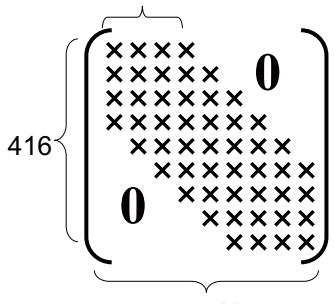
Global equation of motion $\mathbf{M}\ddot{\mathbf{q}} + (\mathbf{C} + \omega\mathbf{G})\dot{\mathbf{q}} + \mathbf{K}\mathbf{q} = \mathbf{f}$

$\mathbf{M}$: mass matrix
$\mathbf{C}$: damping matrix
$\mathbf{G}$: gyro matrix
$\mathbf{K}$: stiffness matrix

ω : rotational speed
$\mathbf{q}$: displacement vector
$\mathbf{f}$: external force vector

Banded matrix

Half band width = 16



•All of the nonzero elements are contained within a band.

•All elements outside of the band are zero.

↓

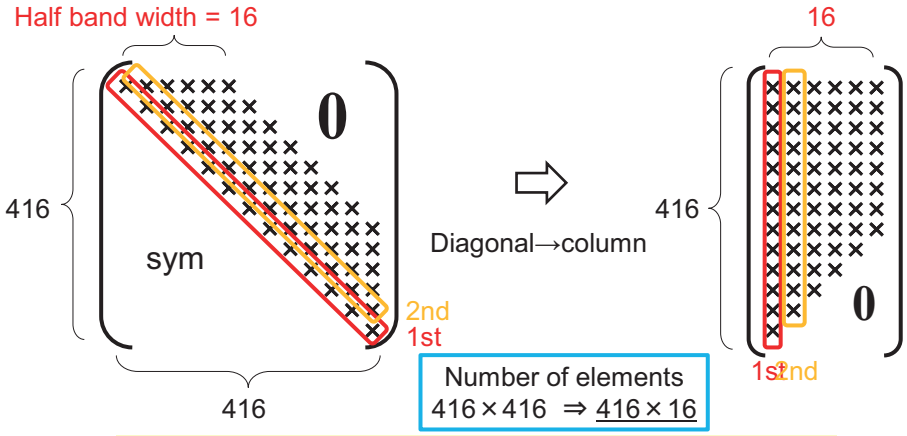
It is possible to reduce

5

Symmetric banded matrix

$\mathbf{M}\ddot{\mathbf{q}} + (\mathbf{C} + \omega\mathbf{G})\dot{\mathbf{q}} + \mathbf{K}\mathbf{q} = \mathbf{f}$: symmetric banded matrix

Only the half of nonzero elements need to be stored.



Number of elements
416 × 416 ⇒ 416 × 16

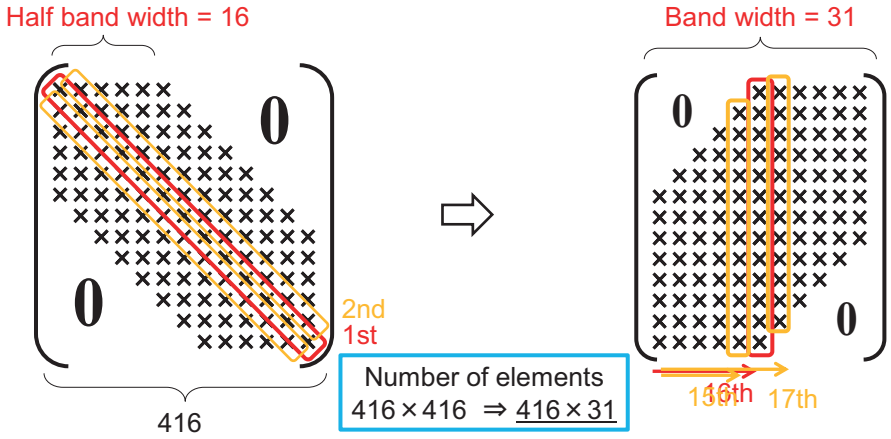
reduce storage of elements and number of operation times

6

Non-symmetric banded matrix

$\mathbf{M}\ddot{\mathbf{q}} + (\mathbf{C} + \omega\mathbf{G})\dot{\mathbf{q}} + \mathbf{K}\mathbf{q} = \mathbf{f}$: non-symmetric banded matrix

All of the nonzero elements need to be stored.



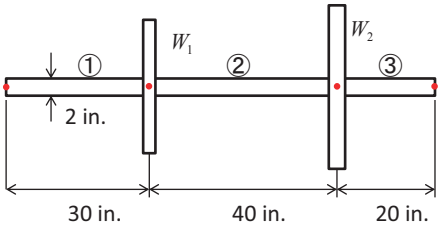
Number of elements
416 × 416 ⇒ 416 × 31

reduce storage of elements and number of operation times

7

Simulation of the eigenvalue analysis

Simple FEM model



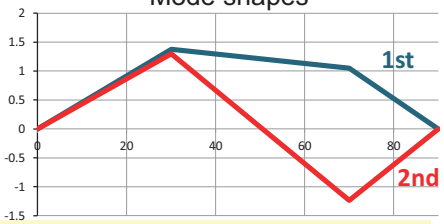
Specification

Number of all elements	3
Number of all nodes	4
Number of degrees of freedom	8
Young modulus	3.0×10^6 psi
Mass density	7.324×10^{-4} lb・s^2/in.^{4}

Eigenvalue analysis result

1st Natural frequency	10 Hz
2nd Natural frequency	33 Hz
3rd Natural frequency	175 Hz

Mode shapes



Eigenvalue analysis program using time reduction method is created

8

Conclusions

Computational time reduction method in FEM analysis

◆I studied FEM

◆Eigenvalue analysis program using time reduction method for non-symmetric banded matrix is created

I will try to use this method in my research in Nagoya to reduce computational time.

9

Simulation of a Compton imager for radioactive material localization

Tohn Takahashi

Quantum engineering, Nagoya university

September 27th,2012

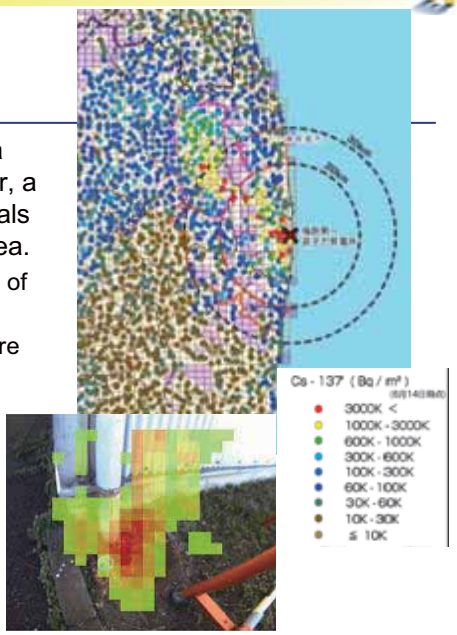
Detection for Nuclear Nonproliferation Group

Overview

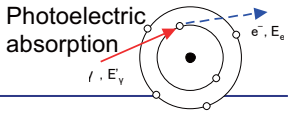
- Motivation for this research
- Principle of Compton imaging
- Simulation of Compton imager

Motivation

- A sever accident has occurred at a nuclear power plant. In the disaster, a huge amount of radioactive materials were released into a residential area.
  - The area must be decontaminated of radioactive material
  - A fast imaging system would ensure efficient decontamination and the security of workers
  - A Compton imager is expected to enable fast imaging
    - Wide field of view
    - Good efficiency (compared to mechanical collimation)



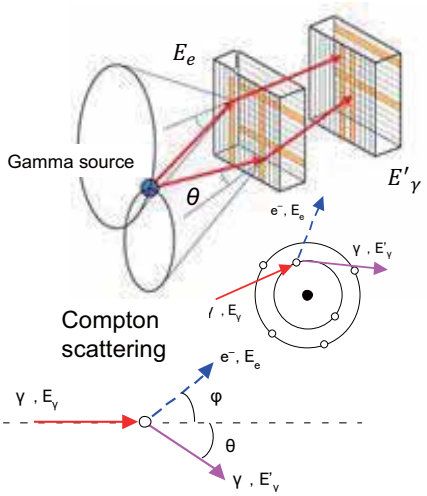
Compton imager
Principle



- We can obtain the energy and the incident direction of the particle from deposited energies

$$\cos(\theta) = 1 - m_e c^2 \times \frac{E_e}{E'_\gamma (E_e + E'_\gamma)}$$

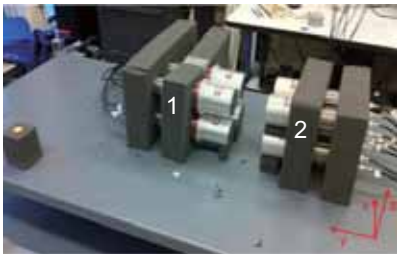
- The modeling of a Compton imager requires a code able to simulate the track of each particle
  - MCNPX-PoliMi (license required)
  - EGS5

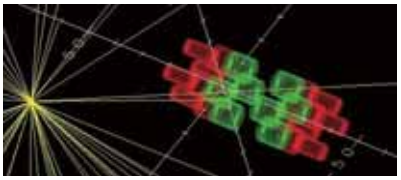


Compton imager

Simulation – Model

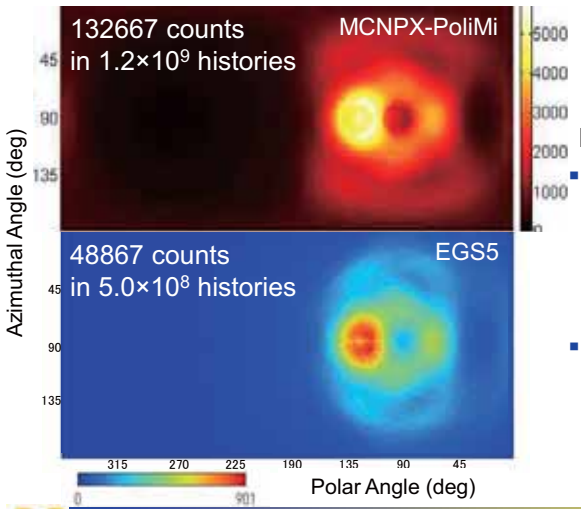
- Detection system specifications
  - Plane 1: 2×2 EJ-309 Liquid scintillators
    - Ø7.6×7.6 cm2
  - Plane 2: 2×2 NaI scintillators
    - Ø7.6×7.6 cm^2
  - The distance between the two planes is 10 cm
- Source specifications
  - ^{22}Na source (511 keV g-rays)
  - Placed on (-30,50,0) from front of plane 1
- Back projection image was obtained by plotting the cones on a sphere surrounding the system





Compton imager

Simulation – Result



Angular resolution: ~40°(FWHM)

For a measurement of ^{137}Cs

- Conditions:
  - ^{137}Cs source: 662 keV, ~ 1 MBq
  - at a distance of 60 cm
  - Measurement time : 10 min
- Expected Results:
  - Total count : ~ 60000 counts
  - Spatial resolution : ~ 41 cm (FWHM)

Summary

- As a preparation for upcoming research, I studied Compton imaging methods
- I learned how to simulate a Compton imager with EGS5
- The simulation result of EGS5 agreed with that of MCNPX-PoliMi
- Simulation method can be further improved to make it more realistic

Simulation of Microfluidic Chaotic Mixer for Efficient Capture of Circulating Tumor Cells

Takahiro Nakashima

Advisor : Professor Jianping Fu

September 27, 2012

Back ground

Circulating tumor cells (CTCs) : Cancer cells in the blood

- To head off the spread of cancer
- To improve the survival rate of patients

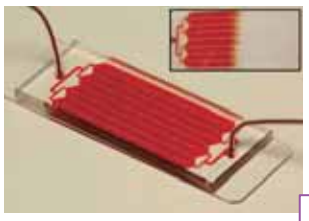
Early detection of CTCs is very important

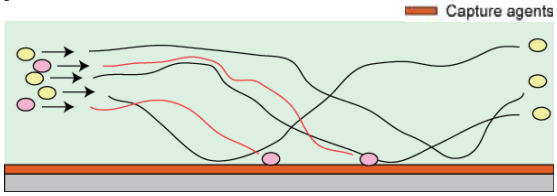
BUT

only 1 cancer cell in 10^9 blood cells ⇒ detection of CTCs is technically challenging

To detect CTCs

CTC-Chip has been developed





・Chip surfaces are coated with cancer-cell capture agents
・Enable to capture CTCs only from the blood cells

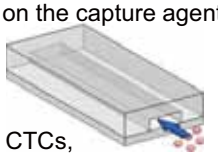
3

Purpose

Normally, flow in the microfluidic devices is laminar

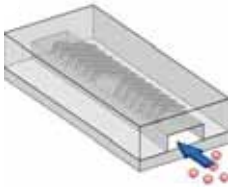
The possibility of cell contact on the capture agent is limited

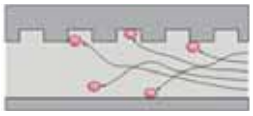
Not Good



To achieve efficient capturing CTCs,
we want to increase the possibility of cell contact on the capture agent

By introducing the herringbone grooves into the CTC-Chip, we make chaotic flow





※Mixing effect depends on the herringbone groove shape

Purpose

To see the influence of the chaotic mixer shape on the mixing effect

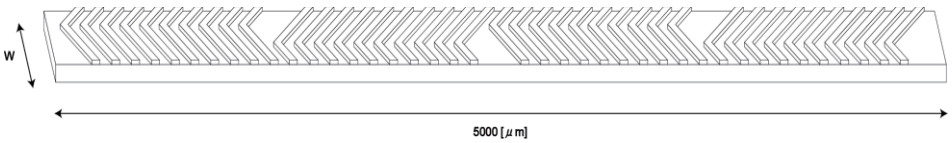
4

Methods

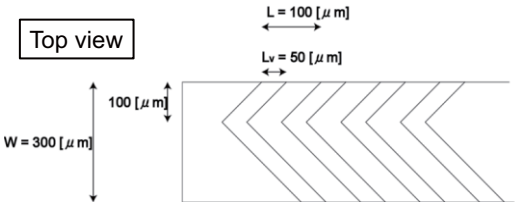
To evaluate the mixing effect, the simulation software COMSOL was used

Simulation model geometry

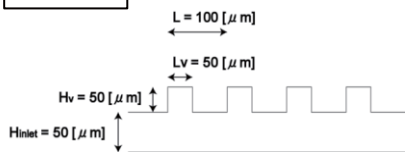
This simulation model shows the flow path that include the herringbone grooves



Top view



Side view



By changing height of channel, width of channel, herringbone height, herringbone length, the influence of the chaotic mixer shape about the mixing effect was evaluated

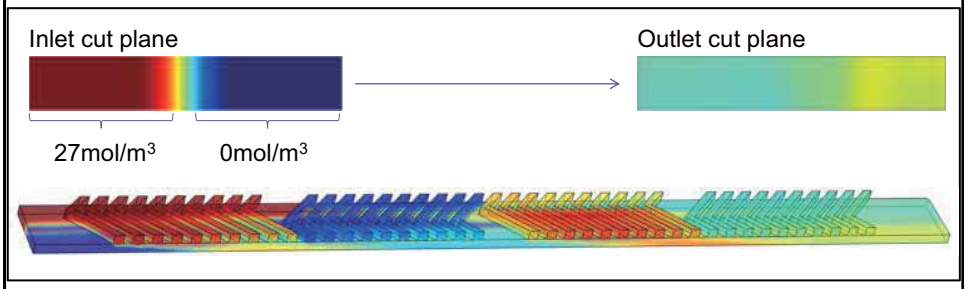
5

Concentration mixing model

In this model, the mixing effect was evaluated by mixing of two water flows

at first The molar concentration of red flow is 27[mol/m^3]
blue flow is 0[mol/m^3]

Due to the effect of herringbone grooves
two flows were mixed, and the color of the flow became green

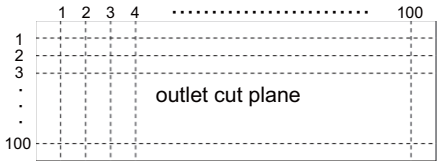


If there are not herringbone grooves…..

6

Concentration mixing model

To evaluate the mixing effect, we defined **Chaotic coefficient**
Chaotic coefficient are represented by **Standard deviation** of outlet cut plane



Outlet cut plane was divided into
10000 points

By using each point's molar concentration, the Chaotic coefficient was calculated

Chaotic coefficient = Standard deviation

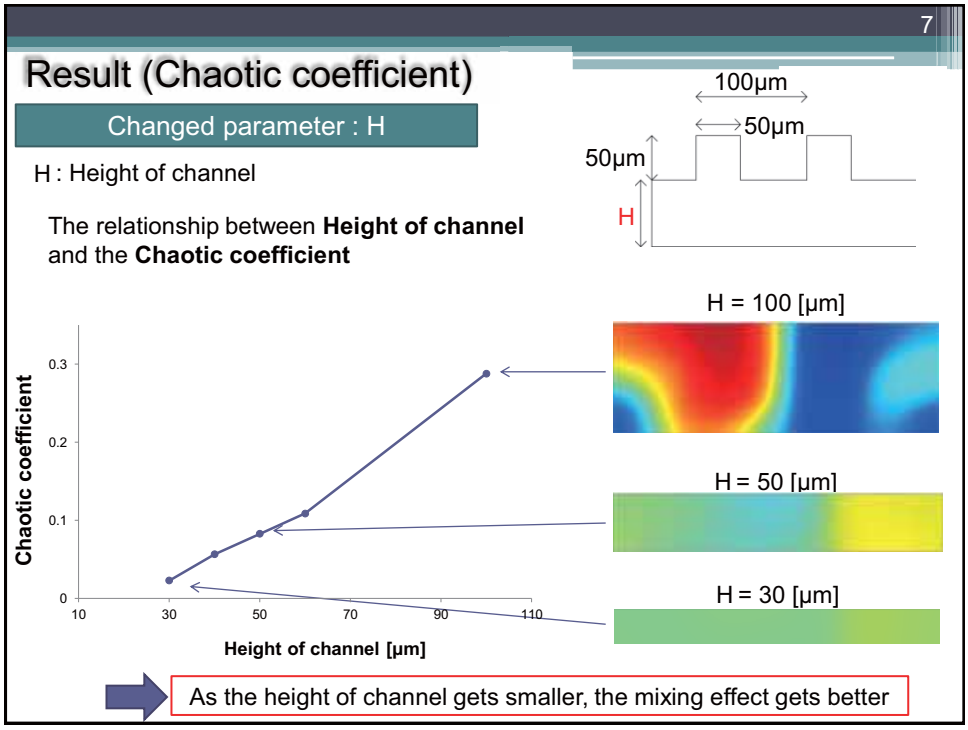
Standard deviation formula

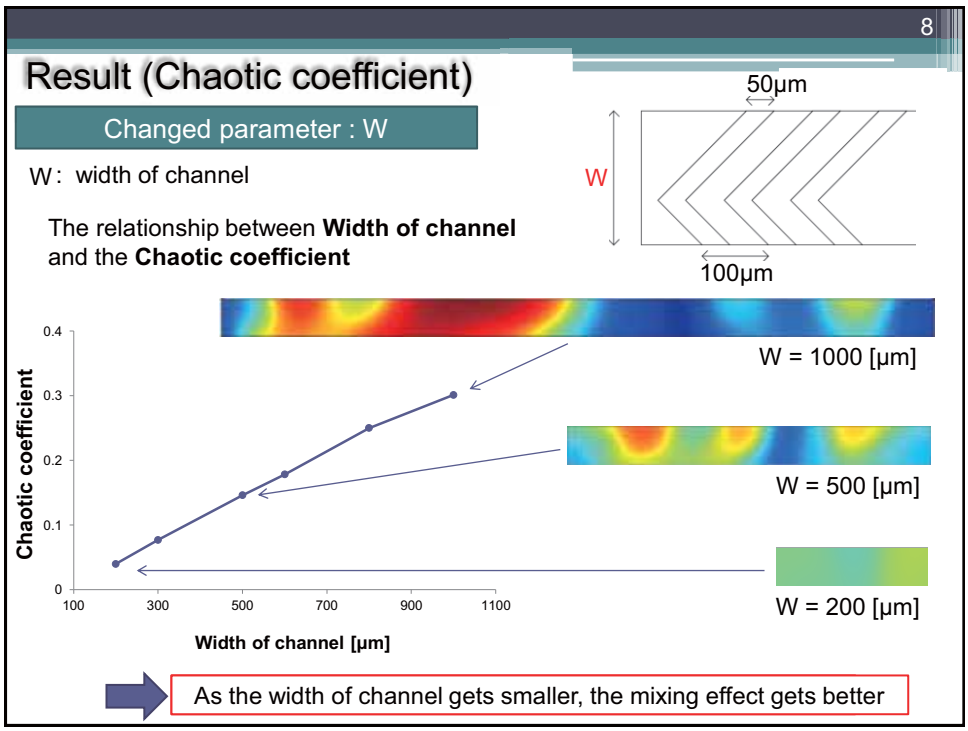
$$\sigma = \frac{1}{M}\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

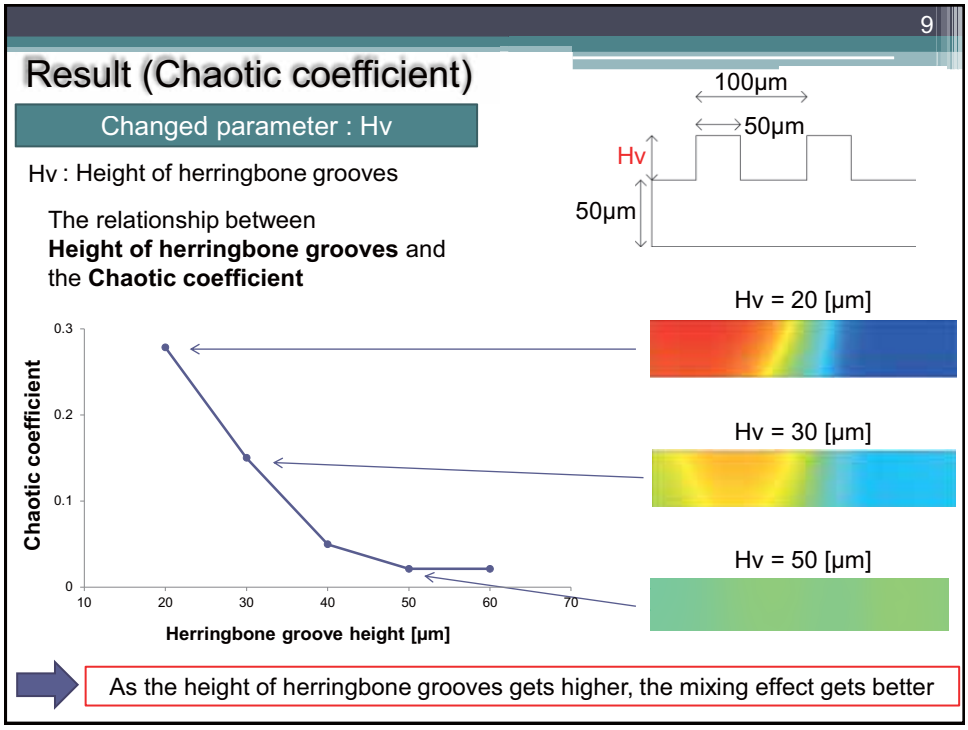
σ : Standard deviation (0~0.5)
M: inlet molar concentration [27mol/m^3]
n : number of point (100 × 100=10000)
x_i: molar concentration [mol/m^3]
$\bar{x}$: average molar concentration [13.5mol/m^3]

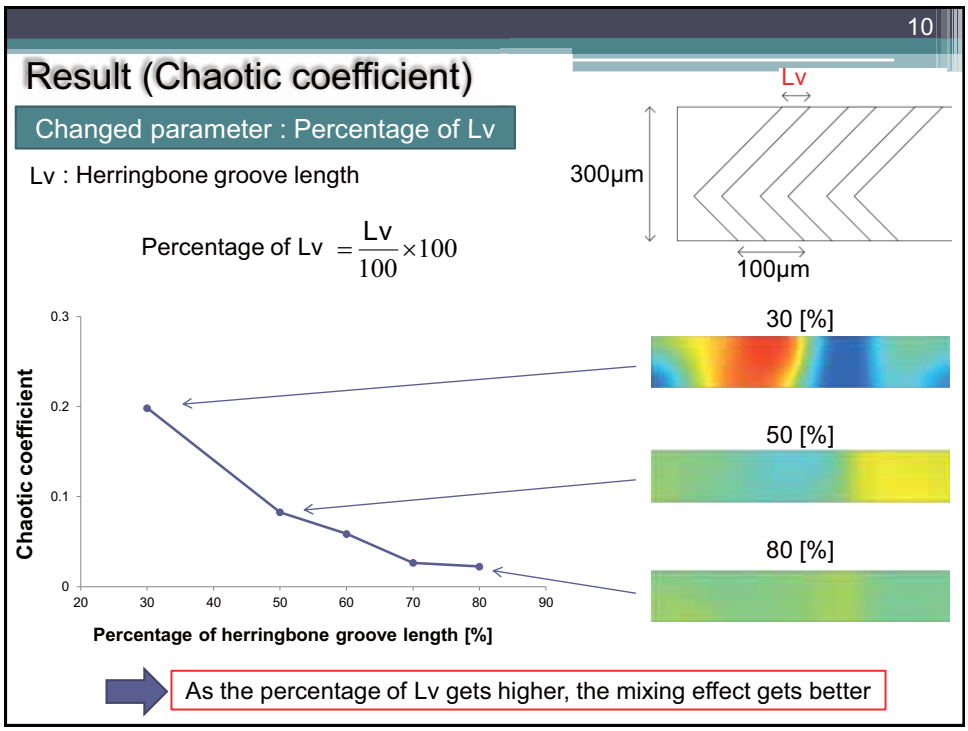
Range of the Chaotic coefficient : 0 ~ 0.5

σ= 0.5 → Not mixed
σ= 0 → Perfectly mixed


7
Result (Chaotic coefficient)
Changed parameter : H
H : Height of channel
The relationship between **Height of channel** and the **Chaotic coefficient**
100μm
50μm
50μm
H
H = 100 [μm]
H = 50 [μm]
H = 30 [μm]
Chaotic coefficient
0.3
0.2
0.1
0
10
30
50
70
90
110
Height of channel [μm]
As the height of channel gets smaller, the mixing effect gets better


8
Result (Chaotic coefficient)
Changed parameter : W
W : width of channel
The relationship between **Width of channel** and the **Chaotic coefficient**
50μm
W
100μm
W = 1000 [μm]
W = 500 [μm]
W = 200 [μm]
Chaotic coefficient
0.4
0.3
0.2
0.1
0
100
300
500
700
900
1100
Width of channel [μm]
As the width of channel gets smaller, the mixing effect gets better


9
Result (Chaotic coefficient)
Changed parameter : Hv
Hv : Height of herringbone grooves
The relationship between
Height of herringbone grooves and
the Chaotic coefficient
100μm
50μm
Hv
50μm
Hv = 20 [μm]
Hv = 30 [μm]
Hv = 50 [μm]
Chaotic coefficient
0.3
0.2
0.1
0
10
20
30
40
50
60
70
Herringbone groove height [μm]
As the height of herringbone grooves gets higher, the mixing effect gets better


10
Result (Chaotic coefficient)
Changed parameter : Percentage of Lv
Lv : Herringbone groove length
Percentage of Lv $= \frac{Lv}{100} \times 100$
Lv
300μm
100μm
30 [%]
50 [%]
80 [%]
Chaotic coefficient
0.3
0.2
0.1
0
20
30
40
50
60
70
80
90
Percentage of herringbone groove length [%]
As the percentage of Lv gets higher, the mixing effect gets better

11

Particle tracing model

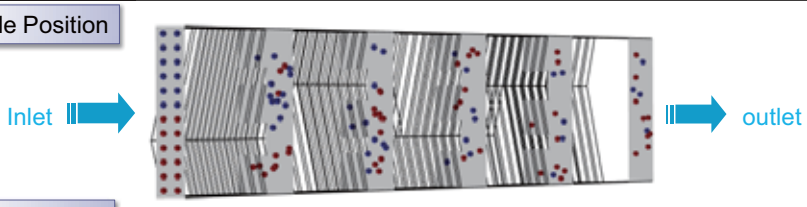
- Former model ignored the size of the particles
- In actual, the fluid is blood, and there are cells

➡ Particles were introduced as substitute for cells into the flow

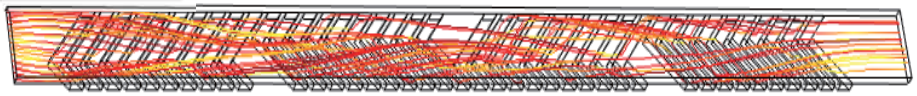
Diameter of particle : 10[μm]
Density of particle : 1000[kg/m^3]

In this model, the mixing effect was evaluated by particle contact possibility on the wall

Particle Position



Particle Tracing



From particle position, the contact number of particles on the wall surface was evaluated

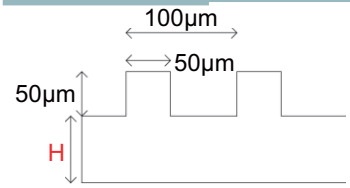
12

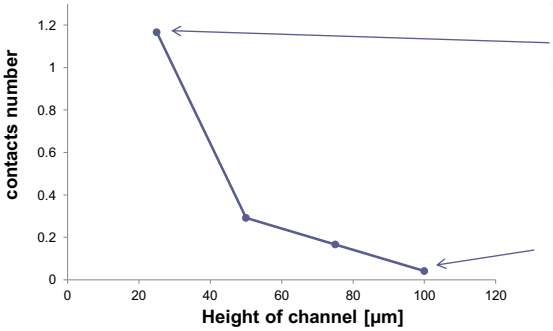
Result (Contacts number)

Changed parameter : H

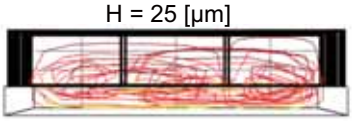
H : Height of channel

The relationship between **Height of channel** and the **contacts number of particle and wall**

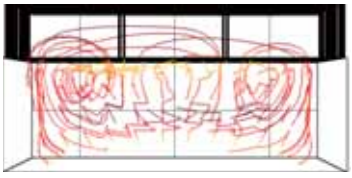




H = 25 [μm]



H = 100 [μm]



➡ As the height of channel gets smaller, the mixing effect gets better

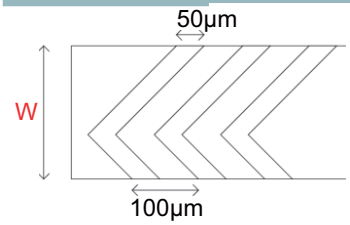
13

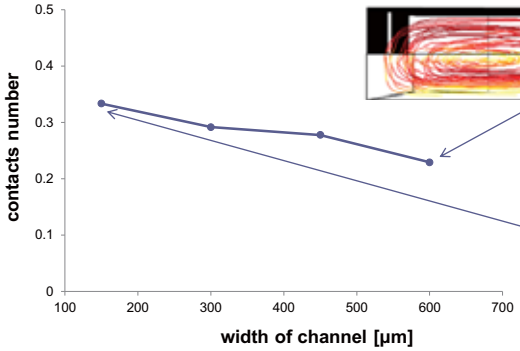
Result (Contacts number)

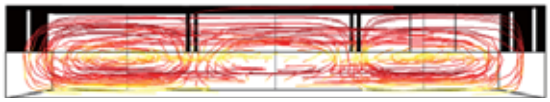
Changed parameter : W

W : width of channel

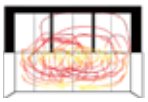
The relationship between **Width of channel** and the **contacts number of particle and wall**







W = 600 [μm]



H = 150 [μm]

As the width of channel gets smaller, the mixing effect gets better

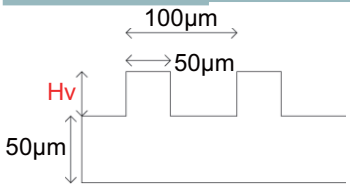
14

Result (Contacts number)

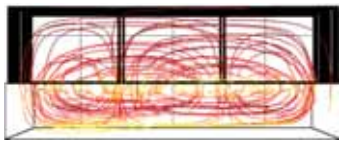
Changed parameter : Hv

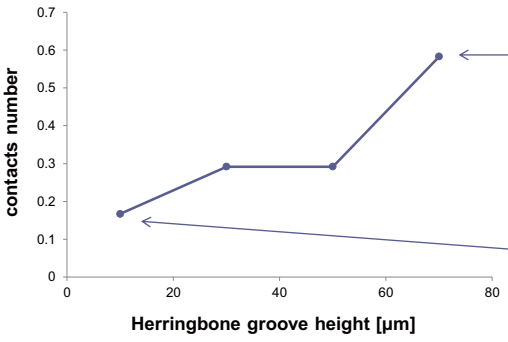
Hv : Height of herringbone grooves

The relationship between **Height of herringbone grooves** and the **contacts number of particle and wall**

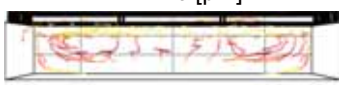


Hv = 70 [μm]





Hv = 10 [μm]



As the height of herringbone grooves gets higher, the mixing effect gets better

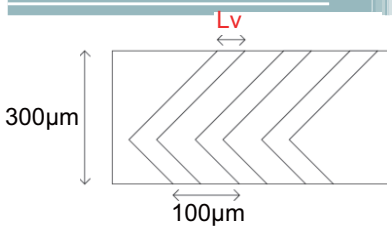
15

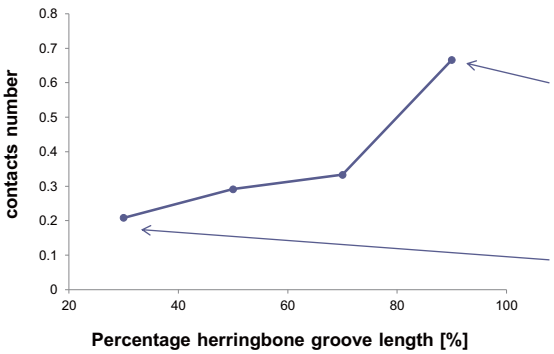
Result (Contacts number)

Changed parameter : Percentage of Lv

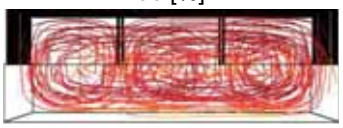
Lv : Herringbone groove length

$$\text{Percentage of Lv} = \frac{Lv}{100} \times 100$$





90 [%]



30 [%]

As the percentage of Lv gets higher, the mixing effect gets better

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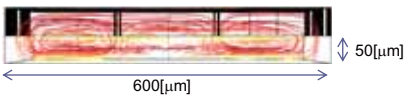
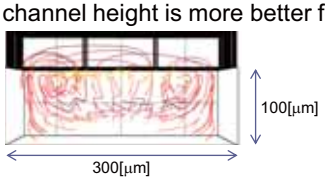
Conclusion

- By using two types of simulation model, I evaluated mixing effect of the chaotic mixer
  In the concentration model,
  - the chaotic coefficient was defined
  - by using the chaotic coefficient, mixing effect was evaluated

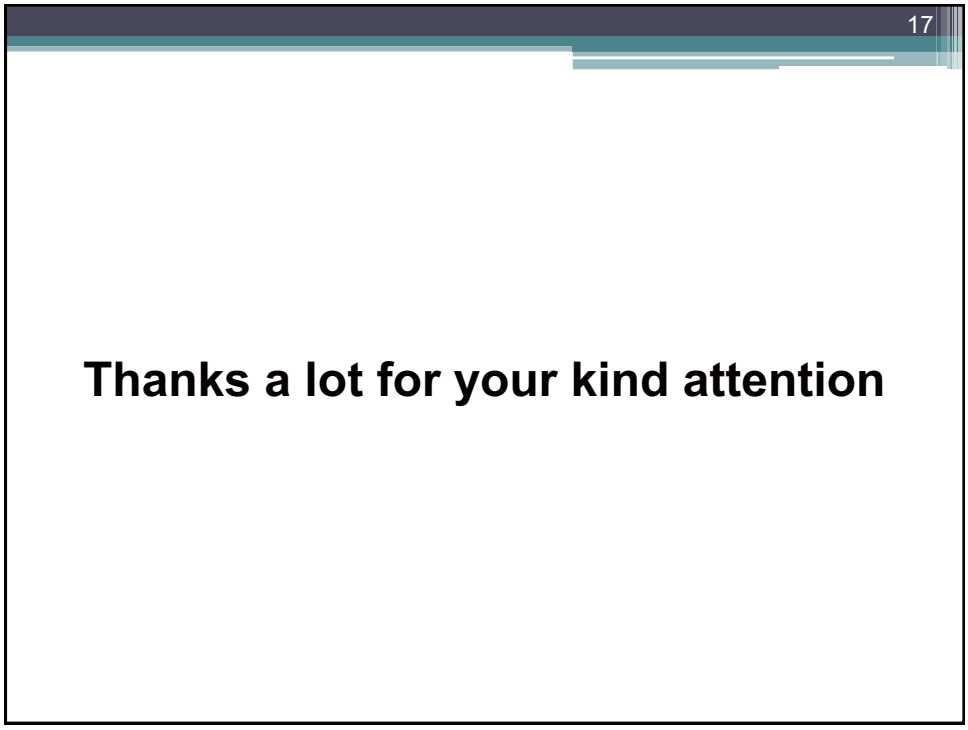
  In the particle tracing model,
  - Particles were introduced as substitute for cells into the flow
  - From particle position, mixing effect was evaluated as the contacts number of particle and wall

- About the channel size, the smaller channel size is more better for the mixing effect
- From the particle tracing model result,
  Comparing the channels of same size, the smaller channel height is more better for the mixing effect





- About the herringbone grooves,
  the higher herringbone grooves height and the higher percentage of grooves length is more better for the mixing effect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Thanks a lot for your kind attention

Literature review of gas micro-pump

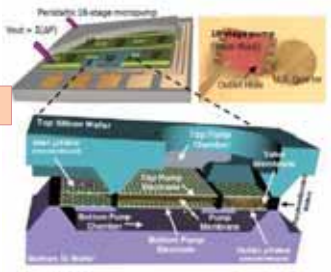
Yosuke Niimi

Table of contents

Gas micro-pump

Why gas micro-pump is needed.

- The gas micro-pump are used in many applications.
  gas chromatography, resonant/IR sensors…



The micro-pump requires two different flow modes.

- One mode require high flow rate at low pressure rise,.
- Another mode require low flow rate at high pressure rise.

Valve timing

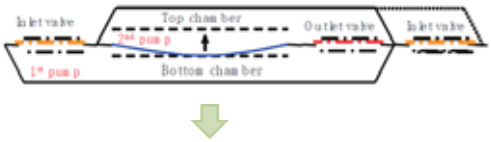
- Pressure and flow rate are controlled by operating the valve opening time and its duration.

Multi stage micro-pump

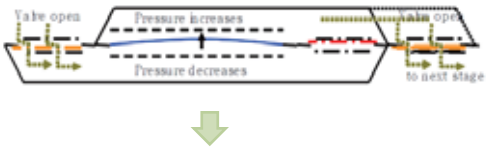
- This pump consists of multiple identical 2-stage units.
- Multi stage micro-pump overcome limitations of tiny volume and slow speed, incomplete compression, etc.

Pumping principles

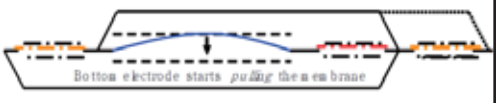
Phase1:
Inlet and outlet valve is closed and top electrode starts pulling the membrane and the membrane compresses the top.



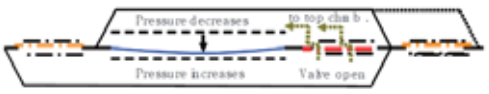
Phase2:
The inlet valve is opened and gas is transferred from the top chamber to the bottom chamber of the next stage.



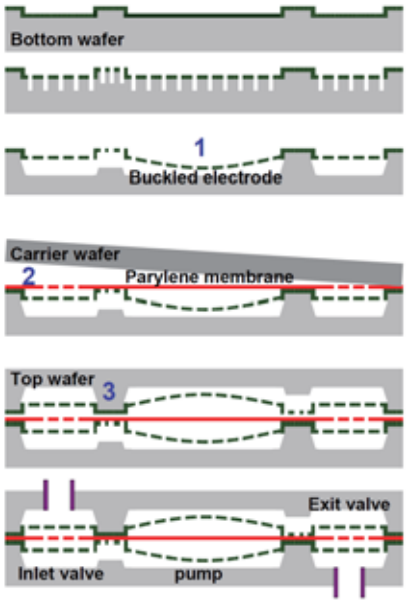
Phase3:
The main pumping membrane is moved down compressing the bottom chamber.



phase4:
The outlet micro-valve is opened, and gas is transferred



Fabrication

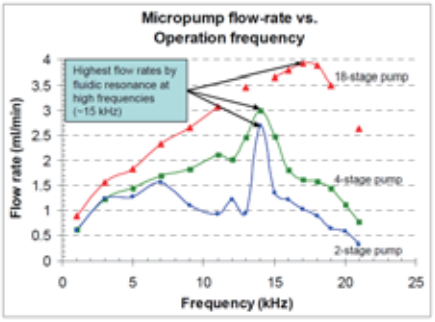


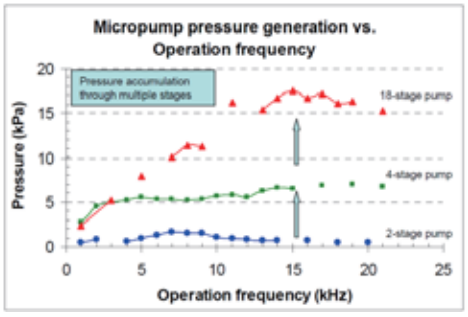
Fabrication process

1. The areas of micro-pumps and micro valves are defined by a shallow recces using DRIE.
2. Wafers are doped with boron and oxidized
3. Perforation holes are etched by DRIE
4. The cavities are formed by TMAH etching
5. Device wafers are coated with a layer of Parylene
6. The second device is bonded to the first device wafer with the transferred membrane on it
7. Inlet and outlet valves are formed by DRIE

Test results

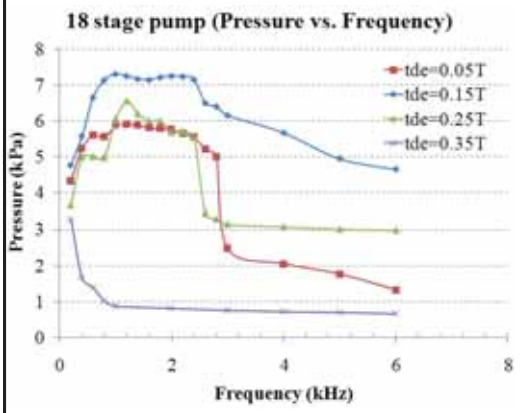
Gas pumping performance of the fabricated 18 and 4 ,2-stage pumps was characterized through the test.
The tested micro-pumps were operated at frequencies and micro-valve timing.



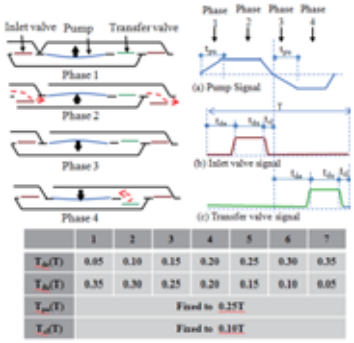


Fabricated 18-, 4-, and 2-stage micro-pumps generated highest air flow rates of ~4.0, 3.0, and 2.7 sccm and produced maximum pressure differences of ~17.5, 7.0, and 2.5kP.

Effect of valve timing



Tested operating conditions

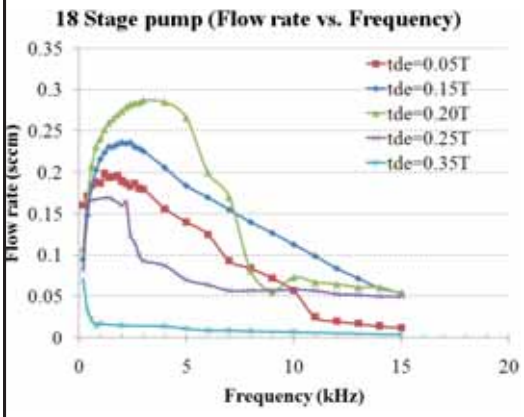


In the theoretical calculation, longer delay time will generate higher pressure.

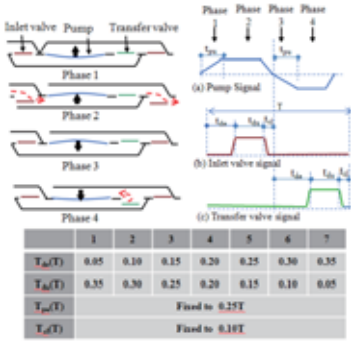
Testing results indicate a peak pressure at delay time(tde) of 0.15T

Valve movement suffers from larger resistance due to higher compression at high delay time and thus reduces valve response time.

Effect of valve timing



Tested operating conditions



- Higher delay time allows more gas flow with the same volume displacement due to higher compression.
- However, as the valve open duration is also shortened with longer delay time.

The highest flow rate is achieved with valve timing of delay time=0.2T.

Conclusion

- The micro fabricated 18-stage pump achieves high pressure (17.5 kPa) by accumulating pressure differences across multiple stages, produces high flow rate (4.0 sccm) by operating at fluidic resonance and high frequency (~17 kHz).
- A series of valve timing (defined as the valve opening duration per period) between 0.05 and 0.35 cycles enabled the fabricated micropump to produce wide ranges of pressure between 7.3and 3.3 kPa and flow rates of 0.29 and 0.07 sccm.

Effective Thermal Conductivity of Lunar Regolith

Abstract

The depth-dependent effective thermal conductivity of lunar regolith is predicted for the first time using elastic (Hertzian) contact theory under lunar gravity. It shows that the radiant conductivity which is proportional to temperature to the third power dominates near the surface, while the deep location conductivity has a weaker temperature dependence.

The predictions near the surface are in good agreement with available experiments. However, at the deep layer below the 500 mm depth, prediction is about half of the Apollo measurements. This may be due to natural sintering of particles.

Ryota Notsu

University of Michigan, Heat Transfer Physics Laboratory

UNIVERSITY OF MICHIGAN

Heat Transfer Physics

Outline

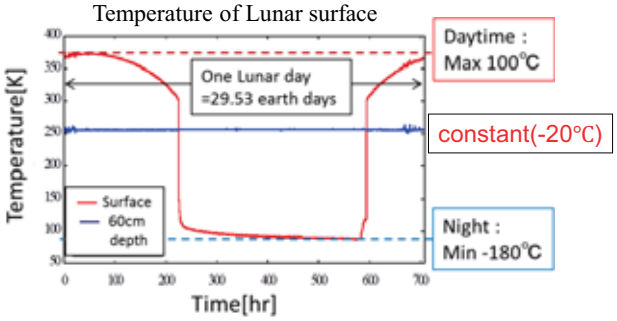
- 1. Introduction
- 2. Models and Calculations
- 3. Results and Discussion
- 4. Conclusions

Heat Transfer Physics

1. Introduction

Extreme Lunar thermal environment

Temperature of Lunar surface



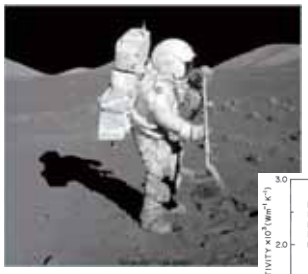
Lunar surface temperature(red line) reaches 100℃ at daytime and -180℃ at night. However the temperature at 60 cm depth (blue line) is constant (-20℃). The reason for this is that lunar regolith (surface soil) has very low thermal conductivity (order of mW/m-K).
→ How about using regolith as a insulator?

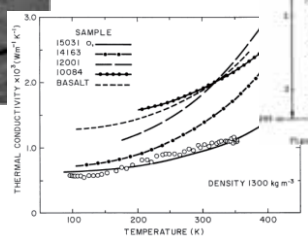
[1] Heiken, G.H,D.T Vaniman, B. M. French., Lunar Sourcebook:

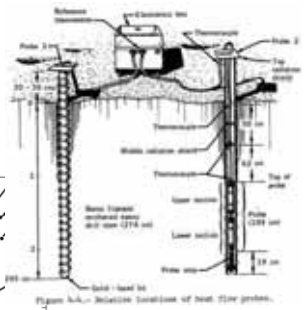
Heat Transfer Physics

Objective of study

- Thermal Conductivity of regolith was already investigated by analyzing Apollo samples and some experiments on the Moon.







However, the depth dependency of lunar regolith effective thermal conductivity has NOT been investigated well. The objective of this study is to predict it.

Heat Transfer Physics

2. Models and Calculations

1. Check the regolith constituents and these thermal properties

2. Predict the pure material thermal conductivity of each regolith constituent under some assumptions

Assumptions
- particles consist of single element
- all particles are spherical and smooth
- packing arrangements depends on regolith relative density

3. Consider the mixture of regolith constituents and effect of particle shape.

Formulas[2]

$$\langle k_c \rangle = k_s \left[\frac{3(1-\mu^2)}{4E} fR\right]^{1/3} \frac{1}{0.531S}\left(\frac{N_A}{N_L}\right) \qquad f = p\frac{S_F}{N_A}$$

$$k_r = 4Fd\sigma {T_m}^3$$

$\langle k_c \rangle$: conduction effective conductivity, k_r : radiant thermal conductivity
k_s : solid htermal conductivity, μ : poisson's ratio, E : young's modulus,
p : pressure, R : particle radius, S_F, N_A, S, N_L : structural parameter depending on packing arrangements
F : radiative exchange factor, d : particle diameter, σ : stefan-boltzmann constant, T_m : mean temperature

[2]Kaviany, M., Principles of Heat Transfer in Porous Media

Lunar regolith compositions

- Mineral fragments
- Pristine crystalline rock fragments
- Glasses of various kind

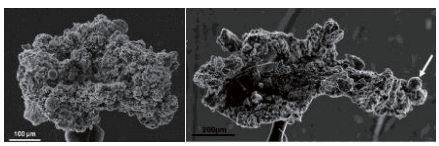
→ Identifiable

- Plagioclase 20%~50% ($CaAl_2Si_2O_8$,$NaAl_2Si_3O_8$)
- Pyroxene 20%~50% ($CaMgSi_2O_6$, $CaFeSi_2O_6$)
- Olivine(Mg_2SiO_4,Fe_2SiO_4) ~10%
- Glass(SiO_2) ~20%

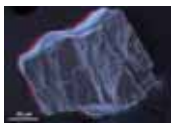
- Breccia fragments
- Agglutinates

→ Difficult to identify
But these are formed by combination of identifiable particles

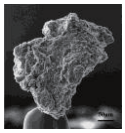
Particle SEM images[3]



Agglutinate particles



Pyroxene particle



Plagioclase and pyroxene particle

Glass particle

These four elements are main components of regolith.

[1] Heiken, G.H,D.T Vaniman, B. M. French., Lunar Sourcebook:
[3] produced by IMRC http://www.lehigh.edu/~inmndust/index.html

3. Results and Discussion

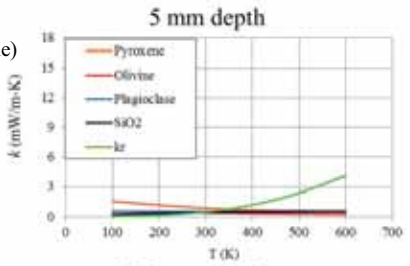
Thermal conductivity prediction of each constituent

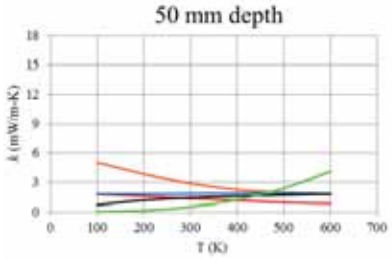
- Effective conductivity (Pyroxene ~ Olivine)

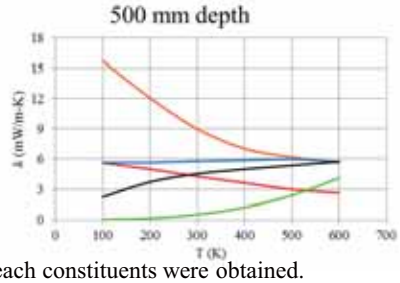
$$\langle k_c \rangle = k_s \left[\frac{3(1-\mu^2)}{4E} fR\right]^{1/3} \frac{1}{0.531S}\left(\frac{N_A}{N_L}\right)$$

- Radiant conductivity

$$k_r = 4Fd\sigma T_m{}^3$$







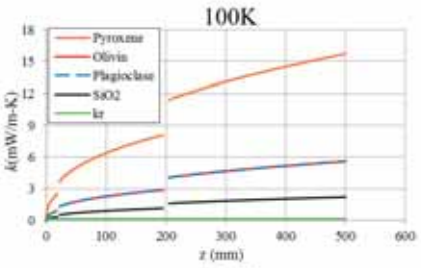
Effective thermal conductivities of each constituents were obtained.

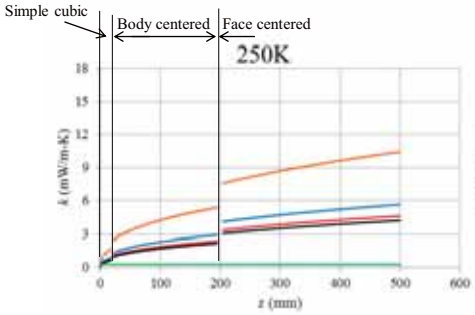
Thermal conductivity prediction of each constituent

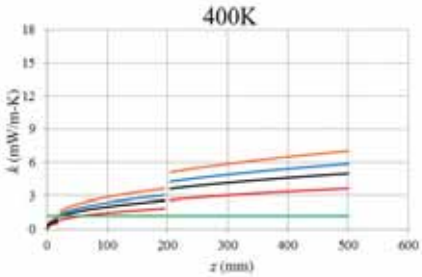
(As a function of depth)

- Packing arrangements assumption
  - 0~20 mm - Simple cubic
  - 20~200 mm - Body centered
  - 200 mm~ - Face centered

※Depending on regolith porosity





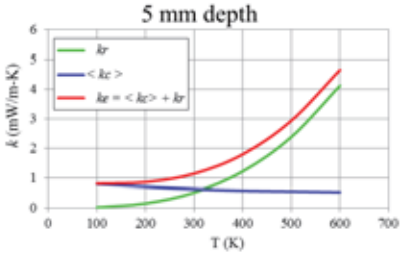


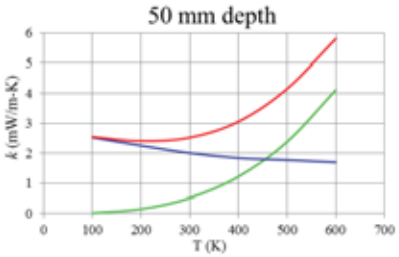
Effective thermal conductivity as a function of temperature

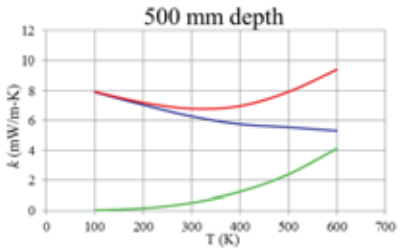
- combine 4 elements by mass proportions weighted averaging.

Mass proportions at Apollo 17 Landing site

Plagioclase	39.3	SiO_2	17.5
Pyroxene	22.7	Olivine	11.6
		Total	96.1







Near the surface, thermal conductivity is dominated by radiation, while at deep layer conduction becomes dominant and thermal conductivity has a weaker temperature dependence.

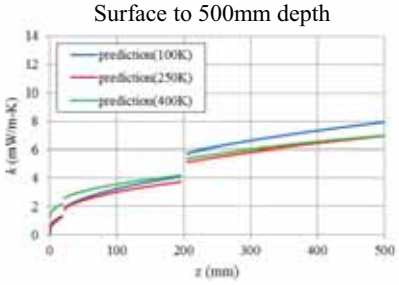
[4]H.R. Rezaei, et al, Thermal conductivity of coal ash and slag and models used

Heat Transfer Physics

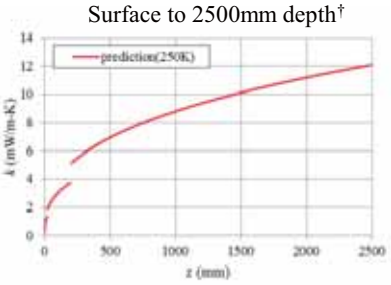
Effective thermal conductivity as a function of depth

- Combine 4 elements and radiation.

Surface to 500mm depth



Surface to 2500mm depth†



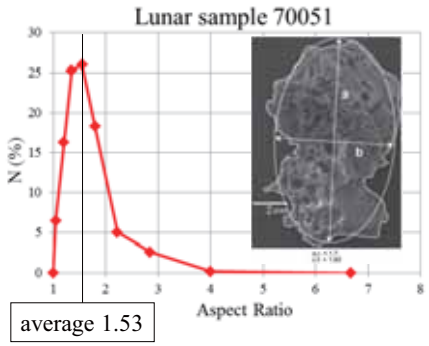
†Temperature below 500 mm depth is almost constant(about 250K).

Regolith thermal conductivity increases sharply near the surface, in contrast its increase becomes gradual with increasing depth.

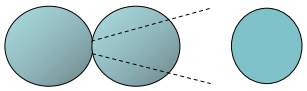
Heat Transfer Physics

Effect of particles shape

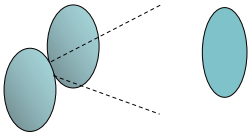
- Regolith particles aspect ratio was investigated by Yang[5]



- Spherical particles



- Ellipsoidal particles



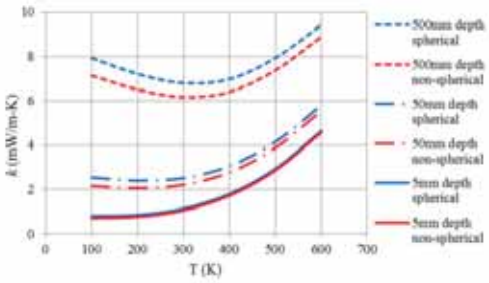
Ellipsoidal particle model has smaller conduction effective conductivity than spherical models.

[5]Yang Liu, Lawrence A. Taylor, Characterization of lunar dust and a synopsis of available lunar simulants

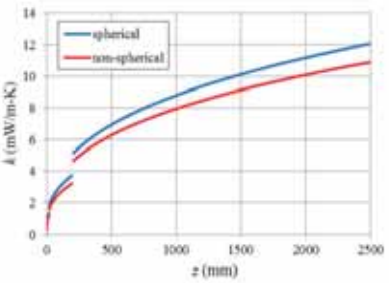
Heat Transfer Physics

Results of considering particle shape effect

As a function of temperature



As a function of depth (250K)

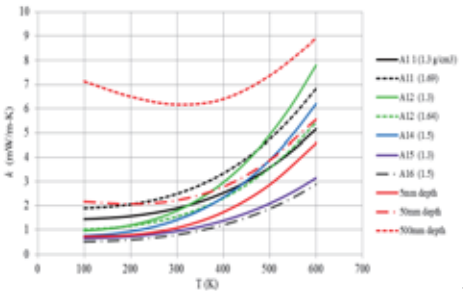


Overall thermal conductivity decrease when considering particle shape effect.
The effect becomes greater as the depth increases.

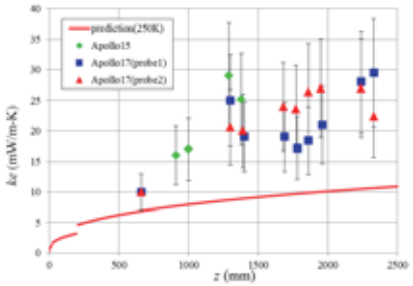
Heat Transfer Physics

Comparison with measurements

- Measurements data were obtained from Apollo samples and experiments on the Moon.



Near the surface (5mm and 50 mm depth), the predictions are in good agreement with the Apollo sample experimental data. At 500mm depth, measurement data is unavailable.



Below 500 mm depth, the prediction and measurements are qualitatively similar, however the prediction is about a half of Apollo measurements. The reason for this disagreement might be neglecting roughness of particles and natural sintering. These might cause increase of the number of contact point and contact area.

4. Conclusions

- Effective thermal conductivity of lunar regolith was predicted under some assumptions using elastic contact theory. As a result, it shows that radiation dominates near the surface, while in the deep layers, conduction dominates and effective thermal conductivity has a weaker temperature dependence
- The effect of ellipsoidal particles was considered in terms of contact area. conduction conductivity of ellipsoidal particles is smaller than that of spherical particles.
- Near the surface (above 50 mm), the predictions of this model are in good agreement with the Apollo sample measurements data.
- Below 500 mm, the prediction and measurements are qualitatively similar, however the prediction is about a half of Apollo measurements. This might be due to neglecting roughness of particles and natural sintering.

Thanks to my advisor, Professor Kaviany, I am very pleased to have a fruitful discussion with you and thanks to my laboratory members for all your help.

Thanks to JUACEP for giving me a chance to study in UM.

References

[1] Heiken, G.H,D.T Vaniman, B. M. French., Lunar Sourcebook: A User's Guide to the Moon, Cambridge University Press, Houston 1991.

[2]Kaviany, M., Principles of Heat Transfer in Porous Media, 2nd edn, Springer-Verlag, NewYork, 1995.

[3] LEHIGH UNIVERSITY "MOON DUST", produced by IMRC http://www.lehigh.edu/~inmndust/index.html .

[4]H.R. Rezaei, et al, Thermal conductivity of coal ash and slag and models used, Fuel 2000,79,1697-1710

[5]Yang Liu, Lawrence A. Taylor, Characterization of lunar dust and a synopsis of available lunar simulants, Planetary Space Science, 2011, 59 1769-1783

[6]K.L.Johnson, CONTACT MECHANICS, Cambridge University Press, Cambridge, 1985

[7]C.J. CREMERS, H.S.HSIA, Thermal conductivity and diffusivity of Apollo 15 fines at low density, Proc. Fourth Lunar Sci. Conf., Vol3, pp2459-2464, 1973

[8]C.J. CREMERS, H.S.HSIA, Thermal conductivity of Apollo 16 lunar fines, Proc. Fourth Lunar Sci. Conf., Vol.3, pp2703-2708, 1974

[9]C.J. CREMERS, Thermophysical Properties of Apollo 14 Fines, J. Goephys. Res., 80(32), 4466-4470, 1975

[10]M.G. Langseth, J.L. Chute, S.J. Keihm, Direct measurements of heat flow from the moon, In. Lunar Science-IV, pp.445-456, 1973

Lifetime Characterization of Magnetoelastic Motors

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Table of Contents

Rotary Micromotors

Microsystem applications

- Medical
- Aerospace
- Robotics

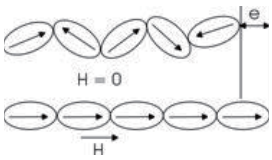
Motor Actuation Method

	Structure	Torque
• Electrostatic →	Simple	Very small
• Electromagnetic • Piezoelectric	Complex	High
• Magnetoelastic →	Simple (Wirelessly actuated)	High

Magnetoelastic Rotary Motor

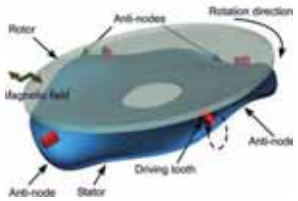
Magnetoelastic material

- Exhibiting strain when a magnetic field is applied
- Another magnetic field is generated by strain



Operation

- Motor is operated by generation of a standing wave in the stator.
- Teeth move in elliptical paths and push rotor tangentially.



Wear is caused

It is important to know about wear effects of the performance of motor

My research

- **Measuring lifetime characterization of magnetoelastic motors**

  ⇨ To evaluate the performance of the motor

- **Proposing different materials of rotor and stator**

  ⇨ To improve wear of that and performance of motors

Research Approach

Approach

In order to measure lifetime characterization of magnetoelastic motors, we tried to observe the followings…

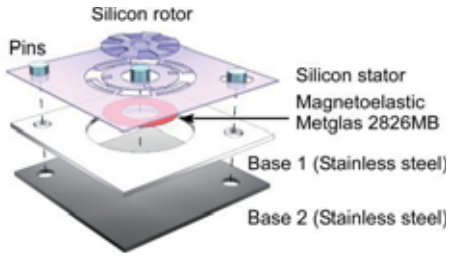
- Rotation rate (rpm)
- Changing the surface profile of rotor backside
- Wear rate of rotor backside (mm^3/h)

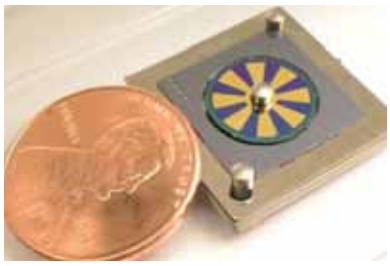
Condition

- The magnetoelastic motors have been running for 24 hours

Experimental Setup

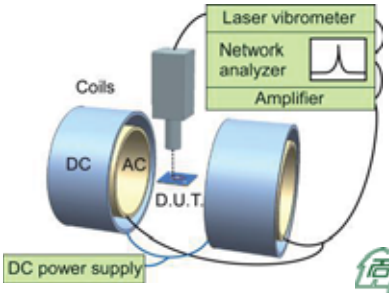
Magnetoelastic motor





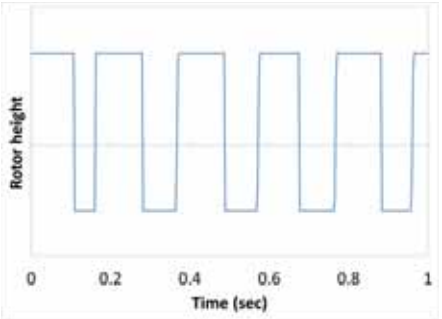
Experimental setup

- The motors were actuated wirelessly using two sets of coils
- D.U.T was placed between the coils

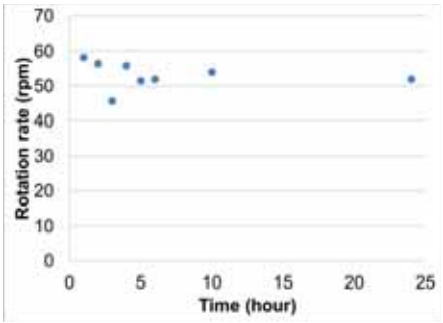


Experimental Result 1 (Rotation rate)

- Rotation rates were measured by monitoring the surface height of the rotor
- Measuring time : 1 h, 2 h, 3 h, 4 h, 5 h, 6 h, 10 h, 24 h



Resulting square wave



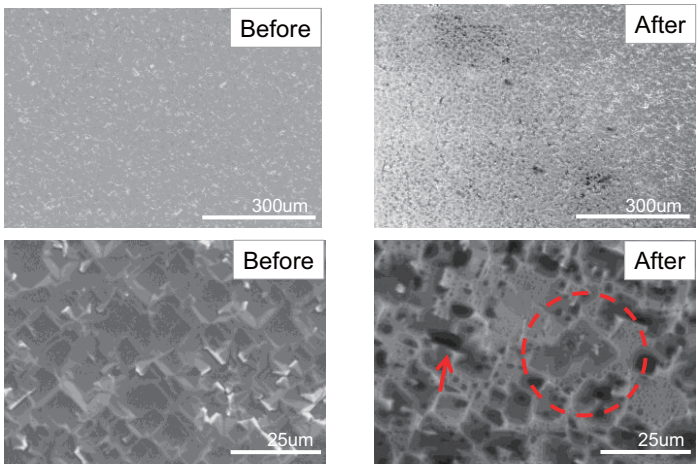
Rotation rate

Rotation rate maintained a constant speed during the experiment

Experimental Result 2 (Surface profile)

- Surface profile of rotor backside were characterized by SEM images

SEM

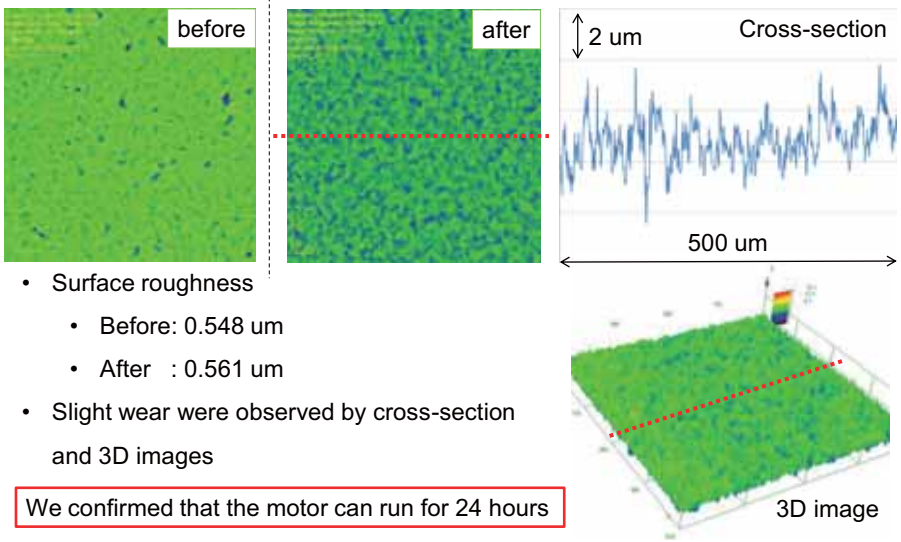


Fragment and small holes were observed

Experimental Result 3 (Surface roughness &Wear rate)

Interferometer

- The surface roughness was calculated by Interferometer.



- Surface roughness
  - Before: 0.548 um
  - After : 0.561 um
- Slight wear were observed by cross-section and 3D images

We confirmed that the motor can run for 24 hours

Summary

- Methods for evaluation and characterization of lifetime of magnetoelastic motor were proposed and experiments were carried out.
- A magnetoelastic motor can run for 24 hours without significant wear and performance change.
- Different materials to improve wear were studied and proposed.

Future tasks

- Increasing testlength (48 h, 72 h, etc.)
- Various test condition (humidity, temperature, etc.)
- Using different materials for rotor and stator

Acknowledgements

- Laboratory
  - Prof. Yogesh B. Gianchandani
  - Jun Tang, PhD student
- Funding
  - Japan-US Advanced Collaborative Education Program (JUACEP)


Thank you for your time

9/27/2012

Dynamic Response of a Bistable-like Nonlinear Piezoelectric Vertical Actuator

Takahito Yoshiura

Vibrations and Acoustics Laboratory
Advisor: Asst. Prof. Kenn Oldham

2

BACKGROUND

- Mobile Micro-Robot (MMR)
  - is light and small.
  - can withstand much greater accelerations.
  - can climb up walls because of adhesion principles.

Beneficial for

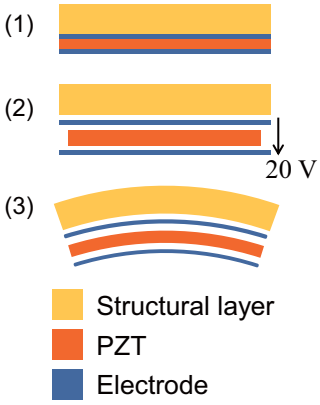
- Rescue from a disaster
- Space missions

etc…

3

PREVIOUS RESEARCH

A vertical actuation for legs of the MMRs utilizing **piezoelectric effect**



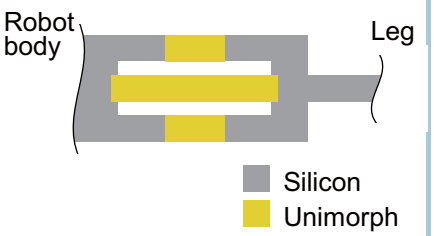
1. Unimorph comprises at least structural layer, top electrode, PZT and bottom electrode.
2. The electrodes create the electric field necessary to distort the PZT layer in between.
3. The contraction force of the PZT layer is transformed into a deflection.

4

SHORTLEG DESIGN

Utilizing a **bistability**

The system has two deflections that equally minimize the potential stress energy when an input voltage is applied.



High weight bearing capability

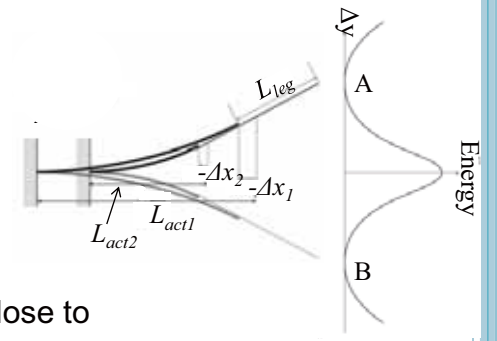
Objective

To investigate the shortleg responses to a change of the number of the beams.

5

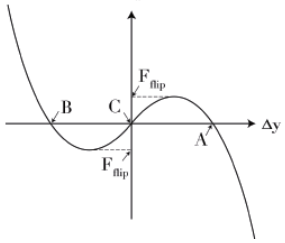
BISTABILITY

The system generates
the greatest force
when the leg is deflected.



Even though the system is close to
the weight bearing capability,
it can still offer a sufficient stroke.

**But, the system is in danger of
getting stuck in negative deflections.**

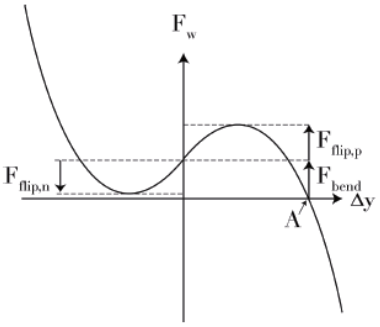


6

OPTIMIZED BISTABILITY

To avoid the system getting stuck in negative position,
we elevate the displacement-force curve
by creating the moment in the unimorphs.

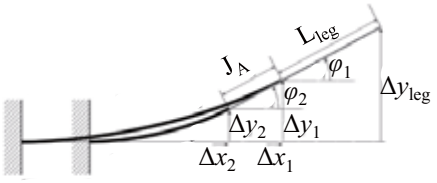
The system has almost no force
for negative deflections,
but significantly improve
the weight bearing capability
for positive deflections.



7

CALCULATIONS

Geometrical relations

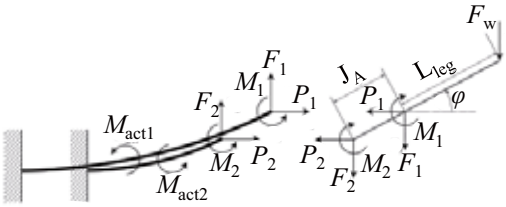


$$\varphi_1 = \varphi_2 = \varphi$$

$$J_A \sin\varphi = \Delta y_1 - \Delta y_2$$

$$J_A \cos\varphi = J_A + \Delta x_1 - \Delta x_2$$

Force relations



$$P_1 + P_2 = 0$$

$$F_w + F_1 + F_2 = 0$$

$$-M_1 - M_2 - F_w L_{leg}\cos\varphi + F_2 J_A \cos\varphi - P_2 J_A \sin\varphi = 0$$

8

CALCULATIONS

Beam constraints

$$\begin{pmatrix} f_{1/2} \\ m_{1/2} \end{pmatrix} = \begin{pmatrix} 12 & -6 \\ -6 & 4 \end{pmatrix} \cdot \begin{pmatrix} \delta_{y1/2} \\ \varphi_{1/2} \end{pmatrix} + p_{1/2} \begin{pmatrix} \frac{6}{5} & -\frac{1}{10} \\ -\frac{1}{10} & -\frac{2}{15} \end{pmatrix} \cdot \begin{pmatrix} \delta_{y1/2} \\ \varphi_{1/2} \end{pmatrix}$$

$$\delta_{x1/2} = \begin{pmatrix} \delta_{y1/2} & \varphi_{1/2} \end{pmatrix} \cdot \begin{pmatrix} -\frac{3}{5} & \frac{1}{20} \\ \frac{1}{20} & -\frac{1}{15} \end{pmatrix} \cdot \begin{pmatrix} \delta_{y1/2} \\ \varphi_{1/2} \end{pmatrix} + p_{1/2} \cdot \begin{pmatrix} \delta_{y1/2} & \varphi_{1/2} \end{pmatrix} \cdot \begin{pmatrix} \frac{1}{700} & -\frac{1}{1400} \\ -\frac{1}{1400} & \frac{11}{6300} \end{pmatrix} \cdot \begin{pmatrix} \delta_{y1/2} \\ \varphi_{1/2} \end{pmatrix} + \frac{P_{1/2}}{N_{1/2} \cdot EA_{1/2}} + \varepsilon_{PZT} + \varepsilon_{gold}$$

$m_{1/2}, f_{1/2}, p_{1/2}, \delta_{y1/2}, \delta_{x1/2}$ are normalized values of $M_{1/2}, F_{1/2}, P_{1/2}, \Delta y_{1/2}, \Delta x_{1/2}$

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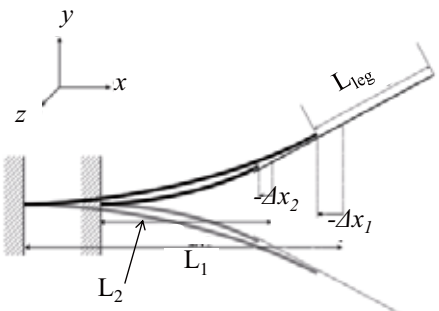
CALCULATIONS

From former nonlinear equations, we can derive a relation of the displacement Δy and the external force F_w .

Simulation condition

The combination of the number of unimorph 1 and 2

N_1	N_2
2	18
4	16
6	14
8	12
10	10



L_1=1000 μm
L_2=175 μm
L_{leg}=1.8 mm

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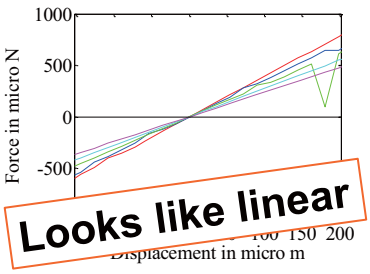
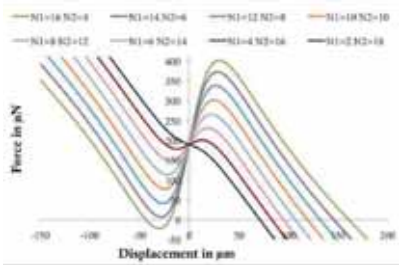
RESULTS



Looks like linear

Red: N_1=2, N_2=18
Blue: N_1=4, N_2=16
Green: N_1=6, N_2=14
Cyan: N_1=8, N_2=12
Magenta: N_1=10, N_2=10

Original bistable behavior



Differences of the two
- Layer thickness
- Piezoelectric coefficient

etc…

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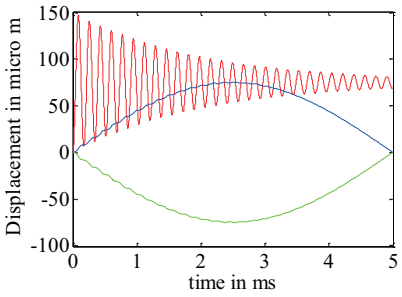
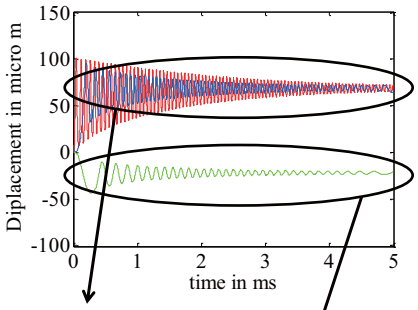
TIME RESPONSE OF THE LEG

Linear behavior



Bistable behavior



Getting stuck
in positive deflection

Getting stuck
in negative deflection

Input voltage

Red: Step (0-20 V)
Blue: 20sin(2πft)
Green: -20sin(2πft) *f=100 Hz

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SUMMARY

- Methods to apply piezoelectric effect to the vertical actuation of the MMRs and advantages of the bistability were explained.
- The relation of the displacement of the leg and the external force was simulated, but the result did not have bistability.
- Time responses of the linear behavior and the bistable behavior were mentioned.

Future work

Try to identify what generates bistability.

Thank you for your kind attention!

Milling Tool Design for High Speed Machining of Titanium Alloys

Nagoya University Ultra-precision Engineering Research Group

Li Gen

Introduction

- In developing a high performance titanium milling process, current industry practice uses experimental approach. However, trial-and-error tests are time-consuming and have become increasingly costly due to rising material costs. Several models show some promise in reducing the need to perform machining trials to find a tool that not only meets manufacturing requirements , but also meet the increasing demand for low manufacturing costs.
- On the other hand, The influences of tool design and chip evacuation ,chip shape prediction has been mostly ignored in current models . Knowledge of the chip evacuation rate and the chip shape, however, is necessary to understand the factors leading to chip clogging.

Objectives

- Understand the milling tool's failure modes
- Understand how does the cutting conditions and tool geometry effects the milling tool performance.

Tool Failure Modes 1

- Chipping is dominant failure mode

Chipping is caused by chatter of the milling tool which is a major limitation in high speed machining.

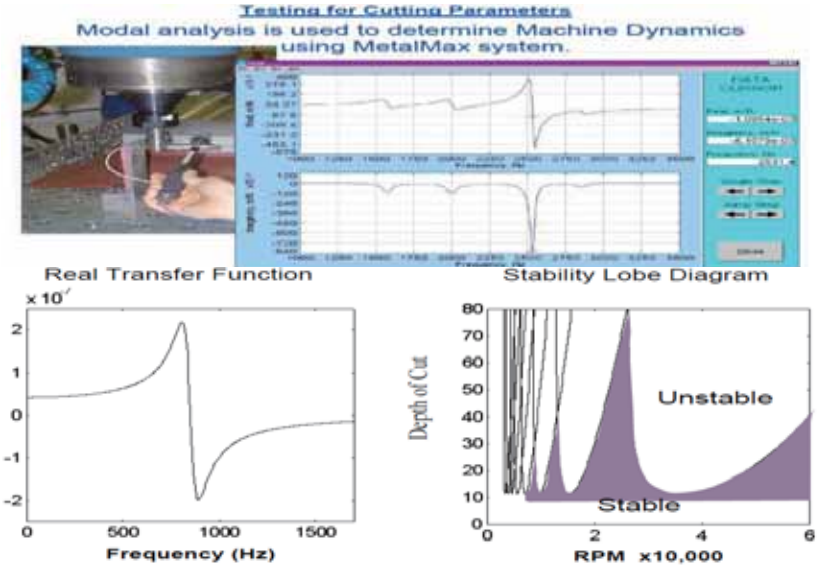
What is chatter?

Chatter is a self-excited vibration between the milling tool and the work piece.

How to control chatter in high speed machining?

1. Choose optimum chatter free spindle speeds by testing Machine Dynamics.

2. Choose optimum depths of cut for each tool set-up



Tool Failure Modes 2

Chip evacuation represents one of the fundamental difficulties associated with the milling process as the depth of cut increases because the chips generated at the cutting lips are confined by the workpiece and the mill flute , the chips tend to cluster together and clog the flutes , causing increased forces, elevated mill temperatures, and mill breakage.

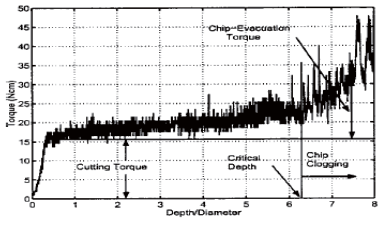


Fig. 1 Typical plot of the torque varying with depth

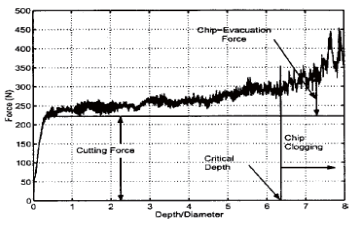


Fig. 2 Typical plot of the thrust force varying with depth

How to avoid the chip clogging ?

Specially designed flutes provide superior chip removal, reducing heat buildup and chip clogging for easier milling and longer tool life.

For aluminum machining tool designs , the rule of thumb is to maximize space for chip evacuation , because aluminum is a very soft material , and the feed rate is usually increased which creates more and bigger chips.

Some materials form very small chips that flow out through the flutes easily. Other materials form chips that are long and stringy.

Other tool geometry effects milling tool performance.

- The number of tool flutes

The number of tool flutes effects the tool strength

- Sharp cutting edges

A sharp cutting edge will create high shearing and also high surface clearance, creating a better surface finish and minimizing chatter or surface vibration. But the cutting age is short.

- The helix angle

A high helix angle lifts the chip away from the part more quickly, but increases the friction and heat generated as a result of the cutting action. A high helix angle is typically used on a tool with a higher number of flutes to quickly evacuate the chip from the part.

Conclusion

- The chipping of milling tools caused by chattering vibration is one of the failure modes.

  Cutting condition such like spindle speed and depth of cut effects the chattering vibration.

- Chip clogging of milling tools is another failure modes.

  Tool geometry such like the helix angle and the shape of the flutes effects the chip clogging.

- Other milling tool geometry such like the number of flutes and the sharp cutting edge of the tool also effects the milling tool performance

Thank you

Relationship between two-phase separation and concentration

Naoya Nakanishi
Takayama Lab
Fukuda Lab

What is ATPS?

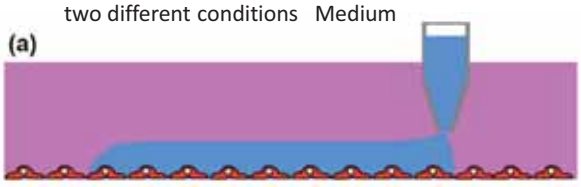
- **Aqueous Two-Phase Systems** are formed when two incompatible polymer solutions are mixed.
- ATPS is applied ranging from spatially controlled gene and protein delivery to patterned biomolecule arrays for high throughput analysis.

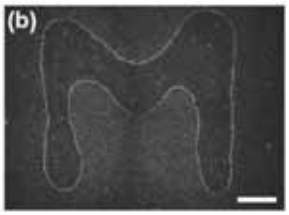
The refractive index of the two phases are different.
polyethylene glycol PEG, dextrin DEX

Purpose

- Learn how to make ATPS.
- What percentage is border to get Two-Phase.
- Propose the new idea for ATPS.

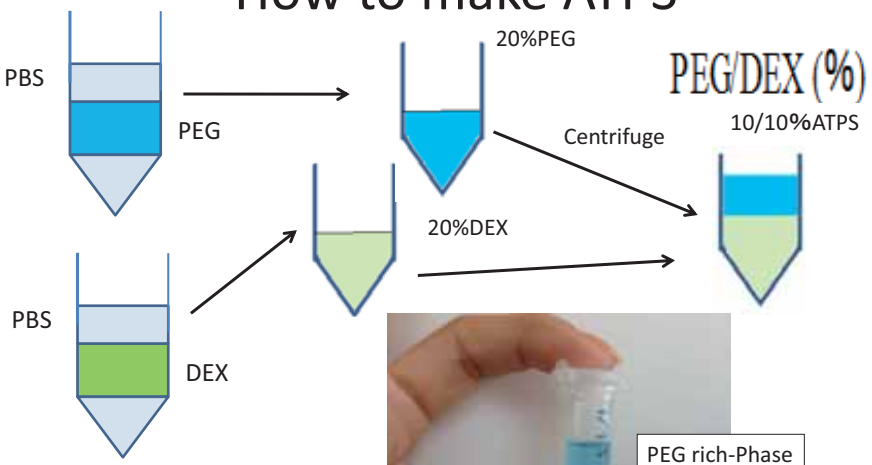
Takayama lab has recently developed a number of unique applications for ATPS.





(a)(b)The denser DEX phase is used as the patterning phase and printed on cells immersed in the PEG phase.

How to make ATPS



PBS is Phosphate buffered saline.

Experiment 1

PEG/DEX (%)

Make the 1/1,2/2….10/10 Percentage ATPS and checked which Percentage can get ATPS.

Result

PEG/DEX (%)	1/1	2/2	3/3	4/4	5/5	6/6	7/7	8/8	9/9	10/10
ATPS	×	△	○	○	○	○	○	○	○	○

This area is border which can make two-phase separation.

Experiment 2

I researched more detailed the suspicious area(2/2~4/4%).

PEG/DEX (%)	1/1	2/2	3/3	4/4	5/5	6/6	7/7	8/8	9/9	10/10
ATPS	×	△	○	○	○	○	○	○	○	○

Result
More detailed.

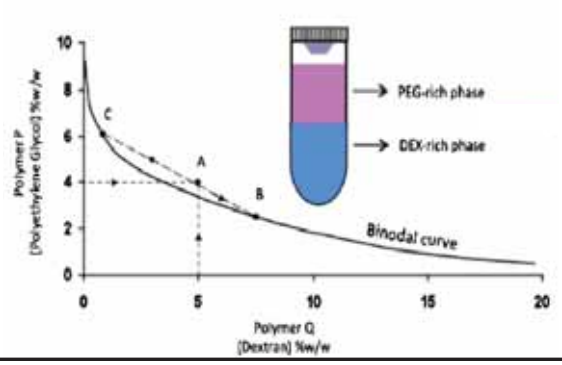
PEG/DEX (%)	2.2/2.2	2.4/2.4	2.6/2.6	2.8/2.8	3.0/3.0	3.2/3.2	3.4/3.4	3.6/3.6	3.8/3.8	4.0/4.0
ATPS	×	×	×	×	×	△	○	○	○	○

This is the border.

3.5/3.5 is good in term of cost.

Discussion

In the polymer solution, the entropy of mixing is small,
So it is depended on interaction between molecules.
Better binding of PEG-PEG and dextran-dextran
than PEG-dextran ,phase separation is more stable.



Proposal for using ATPS

Two-dimensional protein crystals

To create a two-dimensional crystal to align the protein in the two-phase interface,
using the difference of hydrophilic PEG and DEX.

To make Two-dimensional protein crystals is one of the method of structural analysis.

Conclusion

- Dex and PEG mixed with PBS, that I was able to get the phase separation.
- I was able to write binodal curve.
- I proposed the new idea for ATPS .

(using the Difference of hydrophilic PEG and DEX)

THANK YOU

<3>
Reports

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

The Scholarship Report

名古屋大学工学研究科
博士課程前期課程一年
石黒健次

1.

Juacep Program を通して，海外に対する価値観が大きく変化した．また，世界の広さを存分に味わうことができた．留学前の私には海外というものの実感があまりなく，どこか他の世界の話とでもいった具合に考えていたところがあった．大学の生活において，英語を使用する機会はほとんどなく，積極的に留学生と交流しようとすることもなかった．

しかしながら，留学を経験して，世界には多くの人がいることを知った．私が滞在していたミシガン大学には，アメリカはもちろんのことヨーロッパやアジア，アフリカなど世界中から多くの学生が集まっており，お互いが文化的・宗教的背景を尊重しあいながら生活していた．英語での会話に不安を抱えてあまり自分から話しかけることのできない私に対しても，親切に声をかけてくれてくれた．誰に対しても友好的な彼らの対応に，次第に自分から話しかけることができるようになり，異なる文化の人々との歓談の楽しさを知ることができた．現在，日本と中国・韓国との間には政治的緊張が高まっている．しかし，個人の付き合いの上ではこのような国籍は一切関係なく，一人の人間として仲良くなれることを身をもって経験することができた．

留学を終えて，今後積極的に留学生との交流の機会を作りたい，より英語の学習に励みたいと考えている．

2.

今後，留学の機会があれば，再び参加したいと思う．この Juacep Program では，アメリカでの生活というものがどのようなものであるのかということ，様々な国籍の人とのコミュニケーションとること，またいかに英語が重要な言語であるのかということを知ることができた．しかし，２ヵ月という短い滞在期間の中では，意志疎通はどうにかできるようになったものの，流暢な英語を話すことができるようにはならなかった．また，ネイティブの英語のスピードに対応できるようにはならなかった．もし，再び留学の機会が得られるのであれば長期滞在をし，更なる英語力の向上を目指したい．特に，日本英語ではなく，アメリカの生の「発音」や「表現」を身に付けることに専念したい．そのためにも，日常的な英語のリスニング，スピーキングのトレーニングを欠かさずに行っていきたいと考えている．

また，日本を離れて海外で就職するのも一つの選択肢であることをこの留学を通じて知った．そのため，次回の留学では是非とも海外の企業のインターンに参加して，その様子を知りたいと思う．留学を通して見たもの，聞いたものを，体験したことは，今後の人生の助けになると考えている．

石黒 健次

Study Abroad

First of all, I want to thank the JUACEP office and Japan Student Services Organization (JASSO) for giving the opportunity to study abroad. Ever since I was a young girl, I have dreamed of studying abroad. Something about being independent and exploring the unknown always appealed to me. Now, I am studying in Japan as a foreign graduate student. Although my ideal destination has changed from the United States to Japan for a variety of different reasons, I still seek to fulfill that long-awaited childhood dream. I continue to have a strong desire to explore the world around me and to learn and experience a foreign people and their culture. Therefore I really appreciate the opportunity of studying in the United States.

Nowadays, in our changing and internationalizing world, it has become even more important than ever to communicate with people all over the world. Through this program of studying at the University of Michigan, my English language skills have been improved a lot, especially the listening skill. When I was surrounded by English, I needed to pay attention and do some studying, but everything comes faster when you do because English is everywhere on the streets, in the stores, on the TV. I couldn't get away from it. Studying abroad is definitely helpful for learning English.

My eyes are opened to the world. We often grow up thinking that our way of doing things is the only way, or sometimes the best way. But living in a new culture helps me realize new ways of doing things, and also helps me to see that even though we are different , we are all human. And in many cases, not only will you get to know the natives of the country you are visiting, you may get to know the classmates from all over the world. I made a lot of friends in the United States, and I think it is my treasure in my life. By communicating with the global people, my knowledge increased a lot and know the world better. The experience of studying abroad definitely makes me more willing to learn all the time and be a useful person to the whole world. If there is an opportunity to study abroad again , I will take the chance to develop myself.

Qiong Wu

ミシガン大学短期派遣レポート

名古屋大学大学院　工学研究科　マイクロ・ナノシステム工学専攻
材料強度・評価学研究室　281265062　内田　啓太

留学に行く以前、留学に行くことに対して私自身英語力（特にスピーキング力）に強い不安を感じていました。そのためこの留学に行くことを決意するのにすごく迷いました。これまで自分が学んできた英語は受験のためのものがほとんどで、実際に生活の中で使う英語に触れる機会はほとんどありませんでした。そして、自分の英語がアメリカで通用するのがわからず怖かったです。しかしアメリカ滞在中は常に英語を使わないといけない場面、相手の言っていることを理解しなければいけない場面に立たされて、通じるかどうかではなくて通じさせないと何も始まらなく必死で英語を話すしかありませんでした。その中で、これまで私は英語で話すのに文法的に間違うことを恐れて、頭の中で何回も考えて英語を話していました。しかし、日常生活で英語を使うのに多くの場面で英語を頭の中でいちいち考えている時間はありません。そこで、文法が多少間違っていてもいいから自分の伝えたいことを言葉に出すようにしていきました。発音・文法が多少違っても相手は理解してくれるし、会話のテンポが上がってそれまでより楽しく会話ができるようになりました。留学に対して初めは不安と恐れしかありませんでしたが、しかし終えた後は留学の苦労よりも、楽しかった思い出と留学に行ってよかったなという充実感が残りました。
それから、この留学を通して帰国してからももっと英語を勉強しなければいけないなと感じました。自分がこれまで学校で学んできた英語と実際にアメリカの生活で使う英語はだいぶ異なっていました。滞在中自分の伝えたいとこをうまく伝えられない場面に何回も遭遇して、そのたびにもどかしい思いをしていました。自分の思っていることを相手に100%伝えたいのに50%も伝えられなかったのをできるだけ100%に近づけるようにしたいと感じました。

学習の面に関して、研究室でミーティングに参加していて研究室のみんながその人の研究に対して意見したりアドバイスしたりしていたのが印象的でした。他の人の研究に対してどんどん意見していくことは双方にとって有意義なことなので、日本でもこれから少しずつでも意見できるようにしたいなと思います。

国際理解に対してミシガン大学は世界中から留学生が来ていて、滞在中はアメリカ人だけでなく世界中の様々な人種と話す機会が多くありました。研究室はアジア系が中心でしかもそのほとんどの人が日本に来たことがあったり、日本に興味を持っていたりして日本のことをよく知っていました。また話していて、日本に関して一番多く話題に上がるのは漫画・アニメの話でした。予想以上にアニメを通して日本に興味を持つ人が多くて驚きました。逆に私は他の国の文化をあまり理解していなかったのでそこから相手の国について何も話せなくて残念な思いをしました。もっと世界のことについて知識を深めておく必要があるなと感じました。また、宗教の面ではキリスト教やイスラム教の人など日本ではあまり触れあう機会がない人とも話してその文化を感じることができました。

最後にこの留学を通して、また機会があれば短期留学に行きたいなと感じました。そして、その留学をより充実したものにするためこれからさらに英語力特にリスニングとスピーキング力を向上させていきたいと思います。

内田 啓太

ミシガン大学での2ヶ月間研究インターンシップは今までにない刺激に満ちた学生生活だった。日本の学校に通って日本語を話す人つまり日本人に囲まれて今まで生活していた環境からか、外国人留学生が特に多いミシガン大学では非常に奇妙に感じた。話しかけてみればイラン、トルコ、台湾、マレーシア，インドネシアとそれぞれがまったく違う土地からこの場所に集まっていた。今回僕は台湾出身の教授の下で研究活動を行なった。もちろん中国語を話す人も多かったが、それぞれ違う文化をもった人が一つのグループの中で協力し合って、楽しそうに実験している所が印象的であった。また、一旦話し込んでしまうと，気候や食べ物，宗教など話題が尽きず新しいことが次々と発見できて面白い。逆に、日本について興味をもってくれると嬉しく思った。特にアニメについてアジアの子はかなり詳しい。僕の知らないアニメやそのセリフを教えてくれたこともあった。僕の知らないところで、日本の文化が色んな国に広がっていたことに驚いた。また、日本や自分の町について説明していると自分自身が日本にいる時よりも日本という国を理解しさらに好きになった。

また，自分の国から留学に出てくる人たちだからというのもあるのだろうけど，ミシガン大学生は自分でできることはとにかく自分でやっている印象を受けた．特に研究に関して強く印象を受けた．自分の研究に関係があることは非常に深くまで勉強されていて，研究に必要なものは自分で切削して作り，計測に必要なデバイスは良い点悪い点をしっかり理解して使っている．さらに，研究費が多く国から支給される日本とは大きく違って，自分で企業から研究費を獲得するために，プレゼンテーションを考え，研究を紹介し，さらにコストまで考慮に入れて研究されていた．自分の研究テーマに関しては誰よりも深く知っている様であり，教授とのディスカッションでは，相談しているというよりかは，一つ一つの説明を入れながら今後のプランの許可を得に行く場のようだった．ミシガン大学生は研究に対する熱意や責任感が強く，自分自身の学生生活を振り返るとまだまだやれたことはあったのではないか，ほんとに時間を有効に使えていたのかと思う点が多く思い起こされた．また，将来，自立した研究者になるためにも，広い視野を持つことの大切さを学びました．研究に関して言えば人に頼めるところを頼んでしまいがちだったが，すべてのことを自分でできるのかと言えばできないし，できなくて良いというものでもない．ミシガン大学に来る留学生たちは多くを学びとるために，ミシガン大学でできることの可能性を広げる努力をしているようだった．研究に必要なことならなんでもトライする姿勢は非常に自分にとってとても刺激になった．また，あるミシガン大学でできた友達からこう言われた．「ミシガン大学ではあまり日本人を見ない．たぶん日本にはいい大学がたくさんあるし，いい仕事場もたくさんあるから留学して日本を出る必要がないんじゃないかな.」　自分に置き換えると名古屋大学は勉学に対して十分なサポートもあり，その周りは車産業が非常に盛んでたしかに恵まれた環境であると言える．ミシガン大学に来る前は単位をとってこのまま無事に卒業さえできれば良いと思っていた．しかし，ミシガン大学生の多くの留学生たちは自分の国の教育機関に満足せず，自分に必要な技術を学び，腕を磨きにわざ

わざアメリカに渡っている．ミシガン大学から帰った今となっては以前の学生生活がかなりもったいないように感じた．そして，自分の見ていたものは非常に狭い範囲であった．世界にはたくさんの大学や仕事があり，自分の将来の可能性が広がって，今後待ち受けている就職活動も楽しみになった．今回のプラグラムによって，研究面で勉強になっただけでなく自分の意識が大きく変わったことが一番の収穫だと感じている．今後，また海外へ行くチャンスがあればもちろんトライしたいと思っている．

大須賀 耕

短期留学を終えて

2012/10/12

名古屋大学工学研究科　機械理工学専攻
修士1年　大竹伸英

今回の短期留学は私にとって多くの刺激を得ることができた機会であった．私は今まで日本から出たことがなく，今回の短期留学が初めての海外滞在であった．日本で暮らしていた時は外国人と話す機会はほとんどなく，また，日本にいる外国人が困っている様子で道にいても，声をかけることができなかった．そして，異国の文化を肌で感じるという機会はなかった．そんな私にとって，今回のアメリカのミシガン大学への短期留学はとても良い経験となった．

アメリカと日本の違いとして感じたことはまず人種の多様性である．よくアメリカはサラダボールと比喩されることがあるがまさにその通りだと感じた．ミシガン大学は世界的に見ても，とても有名な大学であり，世界中から留学生が集まっていた．私が滞在した研究室に関して言うと，学生は皆，留学生であり，イタリア，スペイン，インド，中国など実に様々な国の人々と出会うことが出来た．また，私の留学期間は8，9月であり，新しい年度の初めと重なっていたため，これから新しくミシガン大学での生活を始める留学生向けのイベントに参加することが可能で，そこで多くの人々と出会い交流することが出来た．このような異文化の人々と交流することは日本では出来ないことであり，互いの食生活や文化の違いについて話すことでアメリカには実に多様なバックグラウンドを持つ人々が生活していることを実感できた．この留学を通して，文化や思想の違い等を知ることができ，様々な立場で物事を考えることが出来るようになったと思う．また，日本以外の文化や歴史，世界の情勢についてもっと知りたいと感じるようになった．

次に，自分の将来についても今まで考えていなかった道を知り，私のキャリアプランを見直す良い機会を得たと感じている．私が滞在した研究室にはPh.DとPost Doctorの学生しかおらず，masterの学生がほとんどの割合を占める日本の研究室とは異なっていた．彼らの中には，既に結婚していて家庭がある人やPost Doctor 2回目の人もいた．Ph.Dを取得してから就職しようと思っている人や研究が好きだからPost Doctorを続けている人など理由は様々であった．また，日本人の正規の大学院留学生やPost Doctorの人に出会えたことも良い経験であった．アジアの留学生の多くは中国人であり，本当に日本人は少なかったため彼らと出会えて驚いた．そして，海外で学ぶことや学位を取ることを実現させている日本人と話すことがとてもいい刺激になった．私は修士を卒業したら就職しようと決めていたが，Ph.DやPost Doctorという道があること，さらには海外の大学院に進学することなど広い視野を持ってこれからの私のキャリアプランについて考えていきたい．

また，私より若い海外の留学生が本当に堂々と人前でスピーチをすることに驚いた．私

の場合，スピーチとなると緊張してしまい聞き手のことまでなかなか考えることはできない．それに対して，彼らは聞き手のことを考えた印象的な話し方をすると感じた．これから，彼らに負けないように成長していきたいと思う．

最後に，私の今回の留学の大きな目的は英語の上達であった．今までの英語の勉強はほとんどが読み書きであったため，何よりも英語を話すことに苦労した．話したいことを瞬間的に表現することが難しく，また発音も正しく聞き取ってもらえないことも多々あった．2か月という期間は私にとっては短く，目的としていたレベルまでの上達には至らなかった．しかし，当たり前のことではあるが，語学を上達させるには長期留学が一番良い方法であると感じた．英語が使えなければ生きてはいけないというプレッシャーを常に感じながら生活するため，必然的に英語を勉強せざるを得ない．また，勉強したことがすぐに実践できるため忘れにくいと感じた．また，英語という１つの言語を話すことが出来たら本当に様々な人と会話することができ，またコミュニケーションが取れるということを再確認できた．今後も継続的に英語の勉強を続けていきたい．また，留学についても積極的に考えていきたい．

レポート

私は、8月、9月の2ヶ月間ミシガン大学の原子力学部でインターンシップを行いました。ミシガン大学では、放射性物質の位置、核種を特定するためのコンプトンガンマカメラに関する研究を行いました。コンプトンガンマカメラは従来のガンマカメラに比べて非常に広い視野と高い検出効率を達成でき、福島第一原子力発電所周辺の放射性降下物の除染作業の効率を高めることができると期待されている技術です。派遣先の研究室では、特殊核物質の測定を目的としたコンプトンガンマカメラの研究をしており、このインターンシップを通して、コンプトンガンマカメラの原理およびシミュレーションの方法を学びました。派遣先の研究室の学生とのディスカッションは、言葉の壁がありかなり大変でした。しかし、一方ではコミュニケーションの問題は言葉の問題のみであり、言葉の問題さえ克服できれば、日本の学生と話すことと変わらないと思いました。語学の面でよりレベルアップすれば、より楽しく有意義な留学が出来ると確信できたため、語学学習や留学に対する意欲が以前より一層高まりました。

今回の留学は、私にとって初めての海外での生活になりました。これまで、海外を旅行したことは何度かありましたが、自分一人で生活するという体験はこれまでの旅行とは比べ物にならないほどの経験になりました。日本とアメリカでの生活で最も違いを感じたのは、アメリカでは人々がみんな自立しているということです。アメリカの社会では全員が社会のために自分の力を発揮して貢献しようという意識が高いと感じました。例えば何か困ったことが起こり、自分の力では解決できないと感じた時には、誰かに助けを求めれば、その人が出来る限りの力で助けてもらえます。一方で、相手に「ここまでできれば後は自分でできる」と判断されれば、あとは自分で解決するように求められます。こういった経験を繰り返すうちに、自分でできることを増やしていけば相手にもっと認めてもらうことが出来るし、逆に自分が社会に対して貢献できることが増えていくだろうと想像することが出来ました。これは、日本で過ごしているときには中々体験しない感覚で、成長して自立し、社会の役に立てるようになっていくことに楽しみを見出すことができるとすら感じました。

また、こういった背景もあってか、アメリカでは自分のやりたいことを遠慮なく主張できると思いました。これは、自分がやりたいことに真剣に取り組んでそれを実現しようと努力すれば、必要なときに必要なサポートをしてくれる人が必ずいるという確信を持つことができるからです。そしてこういったことは実感が薄いだけで、実は日本でも可能なことであるはずです。これまでの私はあまり自己主張の強い方ではありませんでしたが、今回の留学の間に意識が少しずつ変化していったと思います。

今回の留学は自分の研究や学習に役立っただけでなく、アメリカという社会の魅力を学び、自分のこれからの人生の過ごし方を考えるきっかけにもなった非常に貴重な経験になりました。

高橋 時音

JUACEP Summer Program 2012 Report for JASSO

名古屋大学大学院工学研究科 機械理工学専攻　　中島　隆博

留学前，私は留学に関して一つの不安を感じていました．それは英語能力です．事実，日本では英語を用いて会話をする機会は乏しく，留学前，私は自身の英語できちんとコミュニケーションを図ることができるのか，研究活動を進めることができるのかという不安がありました．しかし，この留学プログラムを通して考えは大きく変わりました．実際に留学すると，不十分ながらも私の英語能力でコミュニケーションを図ることが可能ですし，英語が苦手だからと留学の機会を逸することは非常にもったいないと感じるようになりました．留学中，私が最も印象に残っている言葉があります．私の訪問した研究室のメンバーの言葉なのですが，“何を難しく考えているんだ，英語なんてただの言葉じゃないか．それよりも英語に自信がないからと言って，留学の機会を逃す方が問題だぞ．”と言われました．事実，この留学プログラムを通して，私は非常に多くの経験を積むことができました．生活の面はもちろんのこと，研究の面でも多くのことを学びました．アメリカでの生活を通して，そして，ミシガン大学に通う世界各国から集まった学生たちとの交流を通して多くのことを学び，多くの刺激を得ることができました．さらに，研究に関しては，ミシガン大学での研究活動を通して，研究の進め方，研究の議論のやり方など多くのことを学ぶことができました．そして，研究に対する意欲，研究の進め方など非常に多くの影響を受けることができました．この経験を今後にも活かしていきたい，活かさなくてはいけないと感じました．

また，留学先であるミシガン大学には世界各国から多くの学生が留学に来ています．彼らは高い目標を持ち，そして，将来に対して明確なビジョンを持っていました．また彼らは，将来，母国だけでなく世界規模で活躍することを当然のこととして考えていました．彼らとの交流を通して，私の意識も大きく変わりました．ミシガン大学には宗教・文化・習慣など異なるバックグラウンドを持つ学生が生活しています．そして，実際にそのような環境に身を置くことで，将来，世界規模で活躍するためには国際理解が非常に重要であると感じました．

今回の留学プログラムを通して，私は非常に多くの経験を積むことができました．また，非常に多くのことを考えることができました．これらは日本では得難い，非常に魅力的で貴重な経験だったと思います．また，この経験から私の意識も大きく変わりました．この大学院修士課程の段階で留学する機会に恵まれたことを非常にうれしく感じます．次の留学の機会にも非常に興味がわいていまし，また，後輩たちにもぜひ留学を経験してもらいたいと考えています．

中島　隆博　　中島隆博

Jasso report

2012 10 月 12 日

名古屋大学　中西直哉

ミシガン大学に JUACEP のプログラムで 8 月 1 日～9 月 31 日までの 2 ヶ月間の短期留学をしました、ミシガン大学では高山秀一教授の研究室に配属しました。今回のプログラムに参加したのは英語力の向上とアメリカの大学での研究生活に興味があったからです。このプログラムの興味深いところは、自身で研究室を見つけ、自分でコンタクトをとり配属される研究室を決定できる点です。研究室を選ぶ際には研究室ホームページで最も印象の良い研究室を選択しました、結局 2 つの研究室に応募し、リプライが早かった高山研究室に決定しました。渡航までの一ヶ月間は積極的に名古屋大学所属の留学生と交流をし、留学までの英会話の準備をしました、名古屋大学の福田研究室でも英語を使う機会はあるので英会話に対する抵抗はなかったです。ミシガン大学に滞在しまず感じたのは、その研究設備の充実さと一人一人に与えられる研究スペースの広さです、また日本と違い教授に対して対等に学生が意見を言える点にも日本との違いを感じました。滞在期間中は自分の研究に関連がある研究室を訪問したり、ミシガン大学の授業に潜ったりもしました。研究室訪問は事前にメールでアポイントをとりましたが、現地の学生に聞いたのですが、アメリカの学生はアポイントメントがなくても普通に教授室に訪問するそうです。高山研究室ではオフィスに滞在するメンバーはあまりいなく、カフェや図書館、自宅でペーパーワークをしているメンバーがほとんどでした。今回の留学を通して、学んだことは自己主張の重要性と自分で考えて行動することが大事ということです。アメリカの研究室では、教授と対等に意見が言える分、自分で実験を企画し責任を持たなければいけません、その分自分で論文検索等に費やす時間は日本人より多いと思いますし、論文を読んでいて気になった点は直ぐに電話やメールで確認をとっていました。このプログラムを通じて、英語にたいするコンプレックスが解消し海外での就職やグローバル企業に就職したいと考えるようになりました。

中西 直哉

JUACEP Report

281244162　航空宇宙工学専攻　野津亮太

今回 JUACEP の援助の下ミシガン大学へ２ヶ月間滞在し、研究活動を行わせて頂きました。私にとっては旅行以外で海外へ滞在するのも、他大学へ研究をしに行くのも、２ヶ月も自分の家を離れることも全て初めての体験でした。そのため今回のプログラムに関して、海外で上手くやっていけるだろうか…研究が出来るのか…ましてや言葉は通じるのか…友達はできるか…といった不安な気持ちが大きかったことは確かです。

何故今回のプログラムに応募したかというと、私は学部生のころから留学に憧れており、生まれ育った日本という国以外で生活をする経験をしてみたい、また言語も文化も食べ物も全く違う所から来た人とコミュニケーションしてみたい、友達になりたいと思っていました。しかし同時に、自分なんかに上手く出来るだろうか、高い留学費を払ってその分のフィードバックが得られなかったらどうしようといったことを考える弱気な自分もいました。そんな私にとって今回のプログラムは非常にいい機会でした。何と言っても航空券や滞在費など留学に関する費用が奨学金で補われるという事、ミシガン大学というレベルの高い大学に学びに行けるということが決め手でした。今年がプログラムの初年度ということもあり応募が少なかったのか運良く選考に残りミシガン大学へ行けることになりました。ミシガン大学では不安をよそに非常に充実した生活を送ることが出来ました。言葉は通じない部分もありましたが、意外とどうにかなるものです。友達も少なからず出来、帰り際には送別会を開いてもらったりもしました。アメリカの食べ物は美味しかったですが一食の量が日本人には多すぎますので要注意です。

私が今回のプログラムを通して最も強く感じたことはミシガン大学の国際色の豊かさです。キャンパスには多様な人種がひしめき合い、互いにコミュニケーションを取っていました。私が今回知り合った人達もアメリカはもちろん韓国、中国、ベトナム、トルコ、マレーシア、インド等様々な国籍を持つ人達でした。そしてその全ての人々が英語をまるで母国語の様に扱っていたのが非常に印象的でした。さらに話を聞くと３ヵ国語、４ヵ国語を喋れるという人も数多くおり、自分との差、日本との違いを痛感したことをよく覚えています。

次に研究について少し述べたいと思います。自分の受け入れ先の研究室は人数が 3 人と少ない研究室でした。現時点で実験をしている人はおらず、3 人ともシミュレーションを主にした研究を行っていました。学生の部屋と教授の居室は分かれていたのですが、教授が良く学生部屋に来るので皆コミュニケーションは蜜に取っており、僕も教授や PhD の方と話しをして質問しながら自分のモデルを組み上げました。専門用語が分からず何度も聞き

返すことがありましたが、様々な文献を読むうちにだんだんと語彙も増えていきました。

留学を終えて、海外で学ぶこと、働くことに対する印象は大きく変わりました。こと学ぶ内容に関して日本とアメリカで大きな違いは無いように私は感じました。しかし学生たちの学ぶ姿勢や仕事に対するスタンスについて、そして上で述べたような国際性に関して私が思っていた以上に日本とアメリカの間には大きな違いがありました。また、仕事をしながら大学で勉強しているという人、一度就職したがドクターを得るために大学に入り直した人、大学を辞めて働き始めた人、より良い職を求めて転職を繰り返す人等様々なタイプの人がいたことは日本と違って新鮮でした。

JUACEP のおかげで自分の中での留学や海外での生活に対するハードルが低くなったことは確かです。意外と海外での生活はどうにかなる、辛い事よりも楽しいことや得るものの方が圧倒的に多いということは日本に帰ってきた今、胸を張って言えます。もう一度良い機会があれば留学したいとも思いますし、自分のように留学に行ってみたいけどあと一歩が踏み出せないという人に是非ともお勧めしたいと思います。

最後に私にこんな良い機会を与えてくれた JUACEP、そしてサポートをして頂いた全ての方々、共に留学をした仲間達に感謝の気持ちを伝えたいと思います。
有難うございました。

署名　：　野津亮太

Short Exchange Program Report

First of all, I want to thank JUACEP for giving me this wonderful opportunity to study at University of Michigan for two months. I have learned a lot about either knowledge or different culture from this chance.

Actually, I am an international student in Japan, so before I come to America, I didn't feel that much nervous or anxious about this exchange term. On the contrary, I felt so excited about coming here because I am so curious about the study and life in America, and I want to enrich my experience as much as I could. And after I came here, everything is just telling me that that was a good choice.

During these two months, I studied with the laboratory which belongs to Material Science Engineering. After known what researches this lab is related to, I decided to join a project and do some simulation to help other PHDs optimize experiments. Since those staff is totally different for me, so I have to learn everything from zero including elementary knowledge and the simulation software. At first I thought this is such a big challenge for me, and I even thought I cannot complete this job in two month. But later, I told myself that maybe this is what the meaning of this short exchange term is. At least I should try this out, if there is no challenge here how can we improve ourselves by this program. Then I started to ask people in the lab, and they are so nice that answered my questions very patiently. Just like this, I did my project little by little, whenever one problem came up, we can always work it out. In this process, my English speaking skill has been improved a lot through the discussions to other PHD which is a surprised bonus for me. With my efforts and everyone's help, I finished that project in time and did a good presentation in the end.

Reviewing the study I have done here, I found the biggest difference between Nagoya University and University of Michigan is that whether the student would do his/her job independently. Maybe the students in the lab I joined in UM are all PHD, and the students in my own lab in Nagoya are all masters. In UM, the professor will never say anything about what you should do for your research, and he also will not tell you your idea is wrong and you should not do that. He wants everyone to do their work independently even though it was a wrong idea, and he wants you to find it by yourself and that would be your precious experience forever. Actually I think the difference does not just exist between those two universities, it is a difference between two kinds of education systems which belong to Asia and America.

During these two months, we were not only studying, we also went to parties, went to travels, and went to some crazy events which were so American. And all of them are so good and memorable.

This program ends so quickly and I don't want to say goodbye to the friends I just made in UM. If someone asks me will I go abroad to study again, I think the answer is a definitely yes. Next time, maybe it won't be America, or maybe it will be America but not University of Michigan. Just like what I have just said, I want to experience as much as I could when I was young. And this program just confirmed my initial idea about studying abroad.

Again, thank you so much to all the stuff in JUACEP, I had a great time in University of Michigan.

Bai Mingrui

Bai Mingrui

JUACEP SUMMER PROGRAM 2012

マイクロ・ナノシステム工学専攻
松山拓矢

まず、今回の JUACEP SUMMER PROGRAM 2012 に参加しようと考えた動機は、大学生や大学院生がどのような学生生活を送っているのかという事と、海外の大学ではどのように研究が進められているかということに興味があったためです。そのため、今回のプログラムを通じて様々な事を経験したことで、今まで自分の中で勝手に持っていた大学生のイメージが大きく変わると同時に、自分の考え方も変わりました。

具体的には、まず一つ目として海外の学生の勉強に対する取り組み方や考え方です。今回、僕は PhD の方に面倒をみて頂いたのですが、幅広い知識を持ち合わせており自分の知識量の少なさを痛感しまた。また、授業を受けている学生が積極的に質問し、自分の納得がいくまで教授と討論している光景は日本ではなかなか見られないものであり、授業に対する取り組み方の違いを肌で感じました。こうした姿勢は今後見習うべきだと思いました。

二つ目は初めて出会う人を受け入れる姿勢と思いやる気持ちです。僕の面倒を見て下さった PhD の方をはじめ、街で偶然出会った学生の方々がホームパーティーや夜ごはんに誘ってくださるなど、2 カ月間という短い期間しか滞在しない僕たちに対して大変親切に接して下さりました。周りに知り合いがいない僕にとっては非常にうれしい事であり、日本にはないもてなし方をして下さったので興味深かったです。留学先のミシガン大学には他の国々から留学してきている方が多かった事や、大学の周りの寮に学生がシェアハウスをして共同で生活している事がこのような姿勢に現れているのではないかと思いました。また、相手に対して興味関心をもって、どんどんと質問をしてくる彼らの姿勢は大変勉強になりました。異国の地での生活で感じる孤独感と周りに温かく歓迎してもらえる喜び両方を体験することができたので、これからは自分も外から来た人に対してこのような対応をしていこうと思います。

この他にも実際にミシガン大学での短期留学を通じて驚かされた事は、中国人や韓国人などアジア諸国の留学生の数がものすごく多いのに対して、日本人留学生の数が極端に少ないということでした。現地の学生と話していても、「日本人に会うのは数年ぶりだ」や「ミシガン大学に来てから初めて日本人学生を見た」など、日本人学生が非常に少ない現状を知ることができると同時に、他のアジア諸国の学生のエネルギッシュな姿勢を見て大変危機感を感じました。また、現地の学生からは「どうして日本人は海外に留学したがらないのか」と何度も聞かれました。そのため、自分なりに考えてみました。僕がこれまで海外留学を考えてこなかった理由としては、「日本での生活に満足している」「英語力に自信がない」「海外留学に魅力を感じない」という理由がありました。しかし、実際に海外留学をしてみると、様々なバックグラウンドを持った人々と交流することができ、そうして得ることができる新たな価値観や考え方は非常に新鮮で勉強になりました。

上述したように、今回の短期留学は日々カルチャーショックの連続であり非常に濃密な2カ月間を過ごすことができました。しかし、2カ月という短い期間では、まだやり残してしまった事や自分の実力が足りなくて達成できなかった事が沢山ありました。そのため、再び留学をするチャンスが与えられるのであれば是非参加したいと思います。また、この経験を今後の生活に生かしていきたいと思います。今回はこのような機会を提供して頂きありがとうございました。

松山拓矢

JUACEP サマープログラムレポート

名古屋大学 大学院工学研究科 機械理工学専攻 安全知能学研究グループ
281242178 吉浦隆仁

今回のJUACEPサマープログラムに参加することで,世界の文化や海外での日本の評価,語学の必要性等,大変多くの事柄について知ることができた.

もともと学部時代から留学はしたいと思っていたものの,時間や特に金銭面が障壁となり,なかなかできずにいた.今回のプログラムは締切直前に耳にしたが,これまでの留学の希望と今このタイミングを逃すともう留学の機会はないという思いから,すぐに申し込んだ.受け入れ先の研究室探しは難航したが,なんとか決まり,プログラムの参加が決定した.そして,実際に行ってみると,欧米人の他に中国や韓国,マレーシア,タイなどのアジア諸国からの留学生も相当数おり,驚いた.逆に日本からの留学生はめったに出会うことはなく,現地の人らからも,よく「なぜ日本人は留学しないんだ?」と問われることがあった.この現状を目の当たりにして,アジアにおける日本の位置がだんだん低くなっていくのも当たり前だと感じた.

今回の留学で,日本の危機感を感じ,日本人はもっと積極的に外に出るべきだと感じたし,実際に留学してみると,もっと海外に出たいという思いは大きくなった.留学の前では,留学や海外での仕事などについてあいまいなイメージしか持っておらず,今回のように受動的に留学の情報を待つことしかしなかったが,留学後にはより具体的なイメージを持ち,積極的に留学について考えるようになった.現在では,卒業を1年遅らし,留学するという選択肢も考えている.

また,語学についても今回の留学中はなんとか伝わるものの,円滑なコミュニケーションを行うには程遠かった.そのため,さまざまな人の留学している背景等をもっと知りたかったと思っている.日本での生活に戻ったあとも,語学に対するモチベーションを維持しつつ,勉強を続けたいと思う.

今回の留学で,体験した主な事柄として,宗教も挙げられる.街中にはかなり多くの教会があり,それぞれがそれぞれの活動をしている.私らも教会の人に声をかけられ,その教会のイベントに招待されていた.教会にはアジアをはじめとした世界各国からのクリスチャンが集まり,ゲームをしたり,BBQをしたり,話をしたりしていた.今回の2か月の留学中に彼らの宗教に対する考えを十分理解することができなかったが,日本では宗教に対して過敏であることを感じた.

今後は就職活動等により留学の機会はなかなか得られないと思うが,チャンスがあればぜひ参加したいし,海外での仕事を視野に入れた就職活動を行いたいと思う.

吉浦 隆仁

Report of JUACEP Program

When I was studying in the university of China , I had a chance to study in Japan for half of a year as an exchange student , when I graduated ,I come to Japan for further study .This time is my second time to study abroad ,my enthusiasm towards study abroad increased because the campus of American university attracted me and I learned a lot from the everyday life living in Ann Arbor about the American culture and also studied a lot in the lab and library of Michigan University .So if there would have a chance to study or work in America , I think I will not hesitate to make the choice to go there because this summer research internship program taught me a lot of things.

The first day when I arrived in America was very impressive ,When I arrived at the airport, the people there were very warm-hearted to tell me who is a stranger where the bus stop is . And When I went to the supermarket , I was surprised that one woman said she likes my friends' shirt when we passed by. I realized that Americans are not shy of helping others and praising others, they will do and speak out what they are thinking about directly.

The library of Michigan University can be used for 24 hours with many computers equipped and the dormitory is very near to the campus ,the sports center is also near and can be used until midnight without worrying about whether the members of club activities are using it or not , and as Ann Arbor is a small city , the downtown with many restaurants and shops even cinema is very near to the central campus of Michigan University ,so no matter you want to study or sleep or do some sports ,shopping or eating , it will take you less time to move on the road and there are less limit of using time .So I think it is easier for students to focus on their study and it will also save a lot of time for students.

This two months' summer research internship gave me a very good chance to study in a top university of America and also gave me the chance to understand the American culture as the same time my interest to study abroad has increased because I really enjoyed the time in Michigan University , it was a good experience for me and it was the best time in my life.

Sign: 唐耙

JASSO scholarship report

Lim Yan Kuang
281241368

My dream as a child was to study abroad in an advanced country like Japan and the United States. I've partially achieved my dream by doing my undergraduate and graduate studies in Japan but after participating in the JUACEP Summer Program 2012 I've achieved my dream. I had the chance to experience the study environment and the difference in research studies in the two top countries leading the world in technology.

Firstly, I would like to write about the academic differences between these two countries. This program is only two months but I was able to attend some of the lectures by the professors there in University of Michigan and work in a laboratory under a Professor. Through this program, I could see the difference in priority for masters programs. In Japan, research work is made first priority but in University of Michigan, masters student are given the option to either take classes or do some research work in order to graduate. Both systems have their own pros and cons depending on individuals. Besides that, PhD students in the University of Michigan are all funded by the laboratory. In other words, PhD students are actually getting paid to do research work while in Japan students are paying school fees while doing research work. I think that the responsibilities as a student and as an employee are different so as the results they produced. I think that all these funding are necessary to get better research results. The lectures there in University of Michigan are also very different from the lectures in Japan. There besides class lectures, students have projects and discussions among students where they have to do outside class hours. This is quite taxing for the students therefore most of them did not have to do research work and write a thesis for graduation.

Next, the culture differences are quite noticeable. As we know, the United States has a lot of people from different countries with different background and cultures. This is very different from Japan where most of the populations are Japanese and there are not much different cultures in between cities. As I am a foreign student myself and Malaysia is a country with different races, I'm able to understand and cope well with the differences but I believe this is a good chance for Japanese as they will not be able to experience this in Japan. Furthermore, they will have to work together with researchers from different countries in the same environment with different beliefs. Another culture shock I had over there was the freedom of speech. Students over there are very aggressive in voicing out their opinions and thoughts unlike Japanese who are more introvert. During these 2 months, I joined some of the activities outside of the University and most of them are very friendly and will tell you their opinions on anything even politics and they expect us to do the same. Therefore some discussions might turn out to be quite heated at times. Next is the tipping service. This is something we don't see in Japan and because of tipping system; servers work much harder to get communication with the customers and made them feel more welcomed.

In a nutshell, I think that this program gave me a chance to see and experience study environment outside of Japan and I was thankful to be able to be a part of this program. If I'm given another opportunity to participate in this program, I would like to participate in the program again for another amazing experience and if there are other chances to go to other countries like United Kingdom

or Germany for exchange student program, I would also really love to participate to see the differences. I think by participating in training program like this, it gives us a different prospect and view compared to visiting a country as a tourist. As a tourist, we can only enjoy the culture and sightseeing but as an exchange student we get to exchange academic views and work on a same project. After this experience I am actually interested in furthering my doctorate studies in the United States.

LIM YAN KUANG

新美 洋介

An essay about stay in Michigan

新美　洋介
マイクロナノシステム専攻
281265216

・How much your enthusiasm towards study-abroad, learning and international understanding has changed or increased before and after the JUACEP program.
・How much your interest to your next study-abroad opportunity has increased as a result of the JUACEP program.

現在，日本では僕はマイクロナノシステムを専攻しており，マイクロシステムエレクトリカルエンジニアリング（MEMS）の分野の研究をしている．今回の留学のミシガン大学先でも，同じ分野の研究をしている研究室へと配属となった．また，ミシガン大学ではMEMS 分野の研究を世界でも先駆けて行っており，実験装置も名古屋大学よりも大変整っていた．

研究室に所属しているPHD や学生も，MEMS の研究分野が好きで情熱を非常に持っていた．そのため，向こうの学生と話すと自分もまたMEMS についての興味がより強くなった．1 か月だけであったが，ミシガン大学の授業を受けることもできた．MEMS 関連の授業は，名古屋大学ではほとんどないがミシガン大学では 1 学期に数個あり，興味を持って聞くことができ，今までにない知識を得ることができた．MEMS に関する様々なプロセスや技術を学ぶことで，研究に対するモチベーションを上げることができた．

またミシガン大学の授業では，学生がグループでMEMS デバイスを設計し，製作して，評価を行わなければならないタスクがあった．日本では，デバイスを最初から設計し製作を行う機会は中々ないように思う．現地の学生は，目的に応じたデバイスの設計，製作，評価を行うことで，様々な知識や問題点を考え修正する能力が養われているように感じた．今回の留学は 2 カ月と非常に短い期間であったため，そのようなプログラムに参加することはできなかった．しかし，今後長期のプログラムに参加できる機会があれば，積極的に参加し，授業も最後まで受けることができればよいと思うようになった．

今回の留学は，海外に訪れるということの初めての体験であった．自分は英語が得意でないのもあり，最初は外国の人と話すのも抵抗があったが，徐々に抵抗もなくなった．それでも最後までに，英語を満足するだけ喋れるようにはならなかった．また，英語の勉強も日本でもっとやることがあったと感じ，日本での準備不足を感じた．そのため，英語を勉強しなければならないという危機感を感じた．それと同時に英語より上達し，外国の人ともっとコミュニケーションを取れるようになった上で，海外留学に行きたいという気持ちが強くなった．今回の留学では，ホテルが共に留学した日本人と相部屋であったが，大学の学生の寮に入れるプログラムに参加できたら良いと思う．

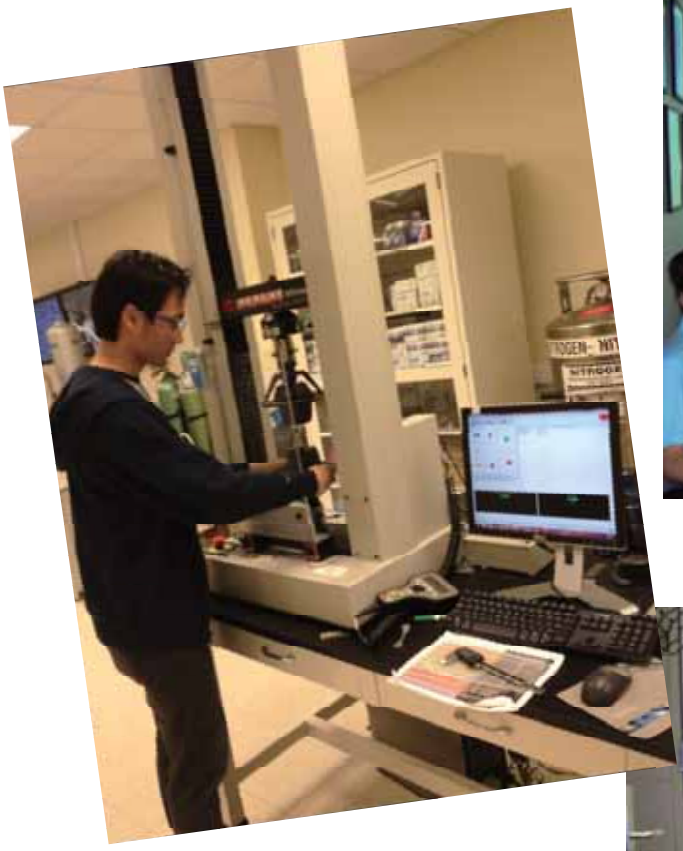
またアメリカのPHD コースの学生は博士課程の後期は給料を貰いながら行えるという

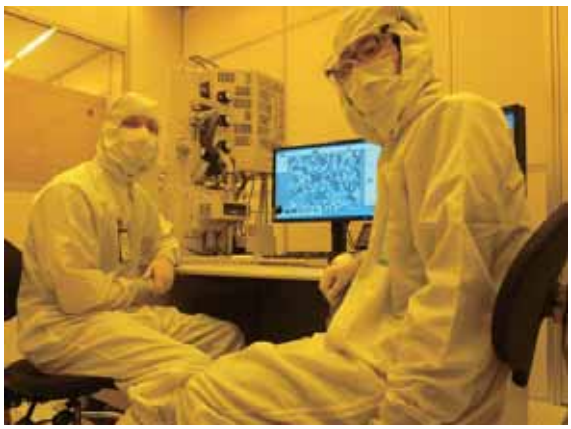
ことで大変興味深かった．PHD コースの学生はそのまま研究職を目指すことができる．給与をもらえるということは，それだけ研究においても成果を残さなくてはならないが，通常の留学や博士後期課程に比べ，金銭面の負担も軽くでき，なおかつ海外で研究が行えるという大変魅力的なものであるように感じた．

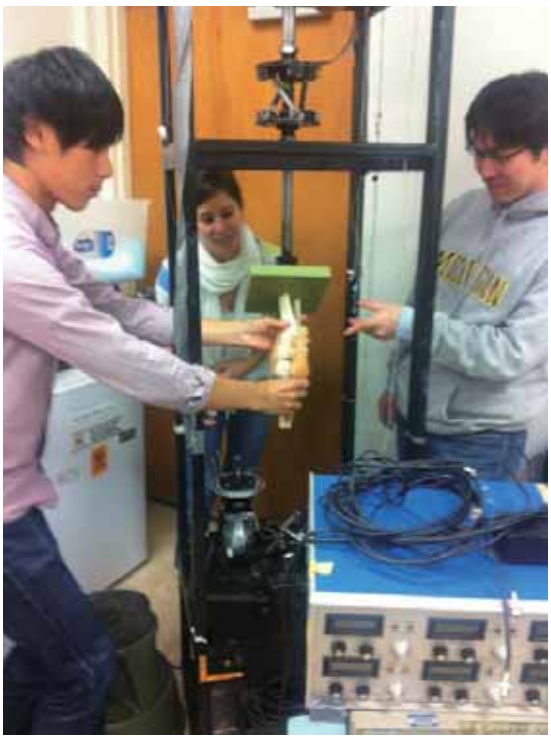
今回の留学を通して，今までなかった経験を体験することができ，自分の世界観が広がったように思う．さらに今後も機会があれば，積極的に留学プログラムに参加し，様々な経験をしていけるようにしたい．

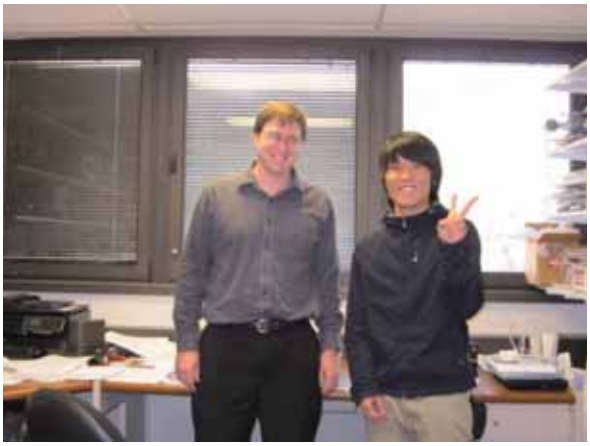
<4>
Appendix

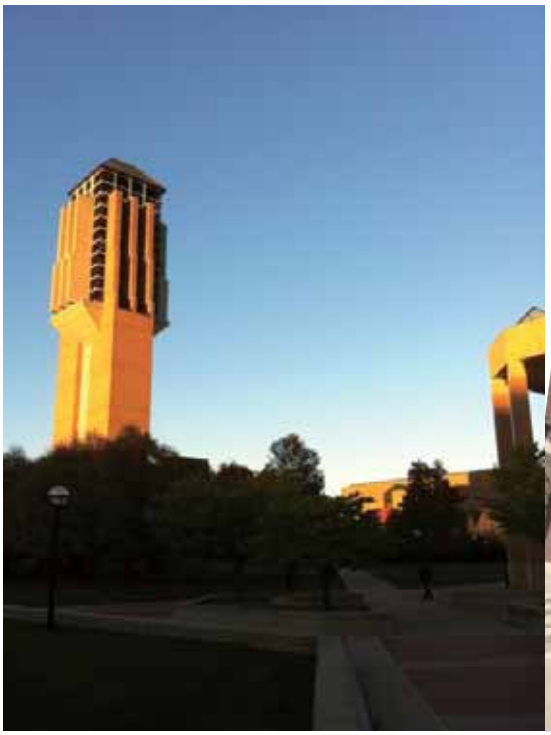
4-a. Pictures











4-b. Handout Materials

Flight Information

[Outbound]

Fri 1 Aug

Flight: Delta Air Lines	Flight No.: DL630
Dep: Chubu Centrair Intl Airport	13:15
Arr: Detroit Metro Intl Airport	12:20

[Inbound]

Sun 30 Sep

Flight: Delta Air Lines	Flight No.: DL629
Dep: Detroit Metro Intl Airport	15:50
Arr: Chubu Centrair Intl Airport	17:55+1

Accommodation

Days Inn Ann Arbor

2380 Carpenter Road, US 23 & Washtenaw Ave., Ann Arbor, MI 48108 US

Phone:1-734-971-0700

Fax:1-734-971-1492

Room Type: 2 Double Beds Room with continental breakfast

For more details:

http://www.daysinn.com/

Assignment of Rooms

1	Kenji Ishiguro	Yuichi Iwase
2	Keita Uchida	Misato Osuka
3	Nobuhide Otake	Tohn Takahashi
4	Takahiro Nakashima	Naoya Nakanishi
5	Yosuke Niimi	Ryota Notsu
6	Takuya Matsuyama	Takahito Yoshiura
7	Li Gen	Lim Yan Kuang
8	Bai Mingrui	Wu Qiong

General Information

Prices

Prices are not fixed in the United States, so stores in Ann Arbor may charge different prices for the same item. You may want to compare prices between stores before you make a purchase. The internet is a good way to do this, especially for brand name items.

Sales Taxes

Michigan's sales tax is 6% (in 2011) for all products except food, medicine and periodical publications (newspapers and magazines but NOT books). The prices at stores do not include sales tax.

Credit Cards

It is safer to use a credit card than cash when purchasing expensive items. A credit card defers payment until you receive a bill once a month. Read the information that comes with your credit card carefully and pay attention to monthly interest fees and late payment penalties. Major credit cards in the U.S. include VISA, MasterCard, American Express, and Discover. Generally most stores accept VISA or MasterCard. If your credit card is lost or stolen, contact the credit card company immediately.

Cash

Carry money in small bills (e.g. $5, $10, $20) because smaller stores may not accept large bills, such as $50 and $100. It is not safe to carry large amounts of cash.

Coupons

Coupons can save you money on food and daily necessities. Coupons are available in newspapers (Detroit News, Detroit Free Press) and online. At the beginning of each term, coupons for downtown restaurants and stores are distributed around campus. Check the coupon's expiration date on coupons and the terms of discount. Give your coupon to the cashier at the beginning of your purchase.

Return Policy

If you are not satisfied with an item or service you have purchased, you should return it as soon as possible. All stores require a sales receipt for a cash refund or credit card refund. If you don’t have a receipt or the item is used, some stores will still exchange the item or give you store credit, depending on store policy. Underwear and bathing suits are almost always not returnable, and some stores do not accept returns on sale items. Ask for details before you buy.

Shopping in Ann Arbor

Clothing

Near Campus

American Apparel - Moderately priced, trendy basics for men and women

Bivouac - Outdoor clothing, boots, shoes, coats, and backpacks

Footprints - Wide range of comfort shoes and boots

Moosejaw - Outdoor clothing, boots, shoes, coats, and backpacks.

Orchid Lane - Wide range of women's clothing and accessories

Pitaya - Inexpensive, trendy clothing for women

Renaissance - More expensive, designer and custom clothing

Sam's Clothing - Levi's, shoes, boots, and coats

Sole Sisters - Moderately priced, stylish shoes and accessories for women

Urban Outfitters - Moderately priced, trendy clothing, accessories, and home goods

Van Boven - More expensive, men's suits and formal wear

Van Boven Shoes - Range of shoes and boots for men and women

Vintage to Vogue - More expensive women's clothing, cosmetics, and candles

Off Campus

Briarwood Mall - Department stores Marshall Fields, JC Penney, Sears, and Von Maur; men's and womens clothing stores including Express, Eddie Bauer, J. Crew, Aldo, Nine West, and Abercrombie & Fitch

Marshalls (Arborland) - Discount brand-name clothing, shoes, and home goods

REI - Coats, boots, backpacks, outdoor clothing and gear

Target (Oak Valley Mall) – Inexpensive clothing, home goods, and more

TJ Maxx (Westgate Shopping Center) - Discount brand-name clothing, shoes, and home goods

Computers & Electronics

On Campus

U-M Computer Showcase (Michigan Union and Pierpont Commons) - Computers and accessories at special prices

Off Campus

Best Buy - Computers, TVs, audio, video

Big George's - TV, audio and video

Kmart - TVs, audio, video

Meijer - TVs, audio, video

Target - TVs, audio, video

Medicine, Contraceptives, Cosmetics, and Personal Care

On Campus

UHS Pharmacy - Prescription and non-prescription drugs and contraceptives. Prices for prescription contraceptives (birth control pills and diaphragms) and non-prescription contraceptives (condoms, contraceptive foams, jellies, sponges) are usually lower than at regular pharmacies.

Near Campus

CVS (S. State St.) - Prescription and non-prescription drugs and contraceptives

The Village Apothecary - Prescription and non-prescription drugs and contraceptives

Textbooks and School Supplies

School supplies are available at all bookstores listed below and at stores like Meijer.

On Campus

North Campus Bookstore

Michigan Union Bookstore

Near Campus

Michigan Book and Supply

Ulrich's

Public Transportation

On Campus

U-M Buses. The University of Michigan operates its own line of buses that anyone can ride free of charge. Blue U-M buses have "University of Michigan" written in large letters on the side, and run between Central, South, Medical and North Campuses. Blue buses and smaller white U-M buses also run between the various buildings of the U-M Health System (including the East Ann Arbor Health Center) and stop at nearby parking lots For a list of routes and schedules, refer to U-M Parking and Transportation Services.

Off Campus

Bus Service. The Ann Arbor Transit Authority (AATA) operates a bus system that services the Ann Arbor and Ypsilanti area. University of Michigan students, faculty and staff can ride the buses for free by swiping a valid MCard (University of Michigan ID).

The AATA operates two transit centers: Blake Transit Center in downtown Ann Arbor on Fourth Avenue between William and Liberty, and the Ypsilanti Transit Center, located on Pearl Street at Adams Street. Most Ann Arbor routes originate at the Blake Transit Center at 15 minutes after and 15 minutes to each hour. For more information about routes and schedules, refer to the "Ride Guide" available at the transit centers, on

the AATA buses, at the U-M International Center, or at the AATA web site listed above.

Taxis. Taxis are a convenient but more expensive way to get around Ann Arbor. The Ann Arbor Area Convention and Visitors Bureau has a complete list of taxi companies. Yellow Cab is one commonly used taxi company. It is usually necessary to telephone for a taxi, but you can often find taxis waiting on State St. outside of the Michigan Union.

Health Care

Hospitals

Depending on which type of health insurance you carry, your preferred hospital may one of two major hospital systems:

University of Michigan Health System (UMHS) 1500 E. Medical Center Drive Ann Arbor, MI 734.936.4000 (general information) 734.936.6666 (emergency department)	UMHS includes an emergency department, three hospitals (the main University Hospital for adults, C.S. Mott Children's Hospital, and Women's Hospital) the Taubman Health Care Center, which houses many of the 120 outpatient clinics.
Saint Joseph Mercy Health System-St. Joseph Mercy Hospital 5301 Mcauley Dr. Ypsilanti, MI 734.712.3456 (general information) 734.712.3000 (emergency department)	

Health Emergencies

Calling an Ambulance

For emergencies that require an ambulance, dial 911.

Emergency Room Visits

For emergencies in which you are able to drive to the hospital, you can also visit emergency rooms of the hospitals listed above. The emergency area of the hospital is clearly marked.

Mental Health Emergencies

If you have psychiatric emergency please go to the emergency room of the hospitals listed above or call the UMHS psychiatric/suicide crisis line at 734.996.4747 (available 24 hours).

Poison

If you have a poisoning emergency, call 800.222.1222 (available 24 hours). If the victim has collapsed or is not breathing, call 911. The Poison Control Center urges all households to have syrup of ipecac on hand.

Urgent Care

These facilities provide walk-in treatment for non-life-threatening illness and non-traumatic injuries. Go to the nearest emergency room or call 911 in any life-threatening situation.

University Health Service (UHS) 207 Fletcher Ann Arbor, MI 734.764.8325 (appointments) 734.764.8320 (information)	Provides comprehensive and urgent care health services for enrolled students (free of charge) and M-Care HMO members whose primary care facility is UHS.
UMHS University Hospital and Children's Emergency Services (information above)	
St. Joseph Mercy Hospital (information above)	

Primary Care

Please contact your health insurance provider to ensure you are visiting a doctor approved under your plan. The following is a list of U-M affiliated facilities, but your insurance provider will have an extensive list of doctors you may also visit:

University Health Service (information above)	
North Campus Family Health Service 2364 Bishop Ann Arbor, MI 734.647.1636	Provides primary health care services to the entire family. The Center offers treatment of acute and chronic illnesses for adults and children, immunizations, prenatal and women's care, and school and sport physicals.

East Ann Arbor Health Center (part of UMHS) 4260 Plymouth Rd Ann Arbor, MI 734.647.5680 (pediatric clinic) 734.647.5640 (family practice clinic)	Pediatric and adult health care provided. Close to North Campus. Staff members fluent in many languages.

Dental Services

Refer to the U-M International Center's Health Insurance, Dental Care page for detailed information on dental care resources in the Ann Arbor area.

Vision Care Services

There are many private optometrists available throughout Ann Arbor area, but before you make an appointment with one, you should make sure you have vision coverage as a part of your health insurance coverage. Your insurance provider will be able to refer you to an optometrist or eye clinic that accepts your insurance.

For a complete list of area eye care professionals, please consult the Yellow Pages.

Listed below are two U-M affiliated facilities:

Eye Care Clinic and Optical Shop (part of UHS) 3rd floor, UHS, 207 Fletcher Ann Arbor, MI 734.763.0291	Provides routine eye exams, contact lenses, treatment of eye disease, prescription frames and lenses, sports, recreational and protective eyewear. Services available to enrolled students, their spouses and dependent children.
U-M Kellogg Eye Center (part of UMHS) 1000 Wall Street Ann Arbor, MI 734.763.1415	Provides comprehensive eye care services.

Crime Prevention Tips

Procedures for Dealing with Law Enforcement: Crime Prevention & Crime Reporting

- Take well-lit and well-traveled streets; do not take shortcuts through wooded areas, parking lots or alleys.
- Don't show large amounts of cash, jewelry or expensive clothing.
- Carry a purse close to your body; put a wallet in an inside coat or front pants pocket.
- Have your car or house key in your hand before you reach the door.
- If you are working late, ask someone to walk you to your car or bus stop.
- Always roll up car windows and lock your car, even if you're coming right back!
- Don't park in isolated areas. Be especially alert in underground parking garages.
- Report all crimes to the police (see the Crime Reporting section below).
- *Telemarketing Fraud*: If you receive phone calls from people offering free vacations or scholarships, or from people asking for donations, it is very possible that the calls are fraudulent and you should ignore them. If you are told to call a 1-900 number for information on these offers, please be aware that you will be charged for these calls.

Crime Reporting

You should report crimes and any suspicious activities that you see. Suspicious activity is an event that is out of the ordinary or should not be occurring.

How to Report Suspicious Activity

- If you need to report suspicious activity, persons or vehicles, dial 911.
- State if it is an emergency. If you say no, the 911 Operator might put you on hold in order to check other lines.
- Stay on the phone and answer all questions. DO NOT hang up until the instructed to do so by the Operator. Follow the Operator's directions because she or he is trained for emergencies and will guide you through the entire process.
- Give your location and the specific location of the suspicious activity.
- Be sure to remain calm and speak clearly.

City of Ann Arbor Offices

Emergencies	911
Fire Department	734.994.2772
Non-Emergency Requests for Police Dispatch	734.994.2911

Non-Emergency Requests to Make Police Reports	734.994.2875
Crime Prevention	734.994.8775
Neighborhood Watch Program	734.994.8775
Anonymous Tips	734.996.3199
Parking Complaints	734.994.2908
Animal Control Complaints	734.994.2911
Recycling	734.662.6288
Solid Waste	734.994.2807

Entertainment

Entertainment Guides

Arborweb

http://www.arborweb.com/

Ann Arbor: Area Convention and Visitors Bureau

http://www.visitannarbor.org/index.php/something_to_do/

Movie Theatres

Michigan Theare

http://www.michtheater.org/

Quality 16

http://www.gqti.com/default.aspx

Theatres (Plays)

University of Michigan School of Music, Theatre & Dance

http://www.music.umich.edu/index.php

Ann Arbor Civic Theatre

http://www.a2ct.org/

Michigan Travel and Tourism

Pure Michigan

http://www.michigan.org/

West Michigan Tourist Association

http://www.wmta.org/

Southwestern Michigan Tourist Council

http://www.swmichigan.org/

*International Center, University of Michigan. (2009). *Life in Ann Arbor.* Retrieved July 5, 2012, from http://internationalcenter.umich.edu/life/