The 21st JUACEP Seminar

第 21 回 名古屋大学日米協働教育プログラムセミナー

“Materials that can replace liquid electrolytes in Li batteries: Superionic conductivities in Li1.7Al0.3Ti1.7Si0.4P2.6O12. Processing combustion synthe-sized nanopowders to free standing thin films”

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ABSTRACT:
Although ceramic materials with superionic conductivities (> 10-3 S/cm) have been reported for pellets or sheets, no such examples exist for thin films (< 100 µm). Also, almost all superionic conductivities are observed in materials produced via glass-ceramic processing method. However, to convert glass-ceramic sheets (1-2 mm) to thin films (< 100 µm), they are ball-milled, tape cast, and sintered to give conductivities of > 10-4 S/cm. Similar conductivities (> 10-4 S/cm) have been obtained for thin films produced using sol-gel derived powders. Nonetheless, sol-gel processing requires calcining powders producing hard agglomerates that are only eliminated using high-energy milling. We demonstrate here that liquid-feed flame spray pyrolysis (LF-FSP) processing provides non-agglomerated nanopowders that can be used immediately to tape cast. Li1+x+yAlxTi2-xSiyP3-yO12 (x = 0.1, 0.3/y = 0.2, 0.4) nanopowders were prepared by LF-FSP with a primary focus on the effects of Al0.3/Si0.4 doping on conductivities. Furthermore, the effects of excess Li2O on Al0.3/Si0.4 doped materials were studied. Li1.7Al0.3Ti1.7Si0.4P2.6O12 pellets sintered to 93-94 % of theoretical density and samples with varying excess Li2O contents all show superionic conductivities of 2-3 × 10-3 S/cm at room temperature. Li2O lowers both the crystallization temperatures and temperatures required to sinter. Total conductivities range from 2 × 10-3 to 5 × 10-2 S/cm in the temperature span of 25° to 125 °C. Small grain sizes of 600±200 nm were produced consistently. Initial attempts to make sturdy, free-standing thin films gave films with thicknesses of 52±1 µm on sintering just to 1000°C. Measured conductivities were 3-5 × 10-4 S/cm; attributed to final densities of only ≈ 88 %.

略歴:
1969年カリフォルニア州立大学化学部卒。1973年南カリフォルニア大学博士号（化学）取得。デラウェア大、UCサンタバーバラ、スタンフォード国際研究所研究員を経て1987年ワシントンテクノロジーセンター研究教授、1990年からミシガン大学物質科学工学部教官。1999年同大教授。Mayaterials 創設者兼CEO、高分子科学工学センター統括者、EXIMOハードコーティング社共同創設者。

Date: **June 26 (Thu), 2014 13:00〜14:30**
Venue: **Lecture Rm. 222 (Rm. 246), Engg. Bldg. Ⅱ)**

＊事前参加申込み不要

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