Institute Interest Seminar Series
February 16th 2017

Low Dimensional Ion-Conducting Nanomaterials for Fuel Cell Membrane Applications

Thomas Bayer

Electrochemical Energy Conversion Division
International Institute for Carbon-Neutral Energy Research, Kyushu University,
744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan

Fuel cells are promising devices for sustainable energy supply, as they efficiently convert the chemical energy of hydrogen into electricity without emitting harmful exhaust gases. Polymer electrolyte membrane fuel cells (PEMFCs) are already successfully used in e.g. stationary fuel cell systems such as ENE-Farm (Japan) and fuel cell vehicles such as the Honda Clarity Fuel Cell. However, high material costs impede a wide-spread commercialization. The development of new membrane materials is an important contribution to the acceleration of fuel cell commercialization.

Despite intensive research on membrane materials over the past 50 years, Nafion is still the standard membrane for PEMFCs. New and unconventional materials may be needed to compete with Nafion and answer the requirements for next-generation fuel cells, such as low cost and higher operation temperature (e.g. 120°C). Nanotechnology has provided novel solutions and performance enhancement in many fields of research due to the unique properties of materials at the nanoscale. Therefore nanomaterials are also a promising route to the fabrication of next-generation fuel cell membranes. Low dimensional proton conductors such as graphene oxide and nanocellulose have thus far shown intriguing properties such as ultra-low gas permeability, high conductivity anisotropy due to ultra-fast proton transport through 1D and 2D conduction pathways, and relatively low cost. Latest results of our research in this area will be reported.