Washington University in St. Louis

International Center for Advanced Renewable Energy and Sustainability

I-CARES Distinguished Speaker Series

Is There A Role for Nano-Materials in Fuel Cells?

Sossina Haile believes in the promise of fuel cells. Fuel cells produce clean energy through chemical reactions; their chief emission is pure water. (To prove that point, Haile once drank the tailpipe emission of a fuel-cell car on camera, as *Newsweek* observed last year.) Such carbon-neutral fuel sources can slow global warming as well as address the world's continually growing energy needs. However, one of the large obstacles to their use is the cost of the energy they produce. Cells which produce power at both low and high temperatures require expensive materials. How can fuel cells be improved so that society can receive their full benefit?

Sossina Haile, Professor of Materials Science and of Chemical Engineering at the California Institute of Technology works to produce fuel cells that generate power at midrange temperatures. She has established a new class of fuel cells based on solid acid electrolytes, and demonstrated record power densities for solid oxide fuel cells. The constraints of high temperature operation and corrosive liquid electrolytes have historically hindered the implementation of nanostructured fuel cell electrodes. Recent advances in the development of solid electrolytes with high conductivity at moderate temperatures, however, open up new possibilities for electrode design and fabrication, and are more durable and cheaper.

In her seminar, Professor Haile will present fabrication strategies for the preparation of nanostructured CsH_2PO_4, an alternative solid electrolyte that enables fuel cell operation at 250 °C, and for metal-ceria structures, suitable for moderate-temperature (600 °C) solid-oxide fuel-cells. Specifically, the electrospray method is shown to be effective for the fabrication of 3-dimensional, interconnected porous CsH_2PO_4 structures; the inverse microemulsion approach (using a non-aqueous solvent) is demonstrated for the preparation of isolated CsH_2PO_4 nanoparticles; and self-assembly of polymer beads is utilized as a mask for the preparation of 2-dimensional, metallic electrodes on ceria electrolytes. In addition to the anticipated benefits for fuel cell performance, such structures enable quantitative evaluation of electrochemical reaction pathways.

Professor Haile earned her Ph.D. in Materials Science and Engineering from the Massachusetts Institute of Technology in 1992. As part of her studies, Haile spent two years at the Max Plank Institute for Solid State Research, Stuttgart, Germany, first as a Fulbright Fellow then as a Humboldt Fellow. In 2008 she was awarded an American Competitiveness and Innovation (ACI) Fellowship from the National Science Foundation in recognition of "her timely and transformative research in the energy field and her dedication to inclusive mentoring, education and outreach across many levels."

Professor Sossina Haile
November 19, 2009
4:00-5:15 p.m., reception following
Lab Sciences 300