7th TcSUH STUDENT/POSTDOC SEMINAR

October 14, 2019 - 5:30 pm, HSC 102

Food and soft drinks will be served!!

Properties and electrochemical performance of tubular, anode-supported, solid oxide fuel cells with varying porosity made by the freeze-casting process

Benjamin Emley

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Abstract: Solid oxide fuel cell (SOFC) technology is an open, electrochemical conversion system that has been demonstrated with a variety of fuels such as hydrogen, carbon monoxide, various hydrocarbons, and solid carbon. SOFCs can offer high power generation efficiency in a variety of sizes and with low emission of CO_2 and air pollutants, because the technology avoids the intermediate conversion of chemical energy into thermal and mechanical energies. Freeze-casting is a relatively new method for fabricating porous ceramic structures and allows for control of the total quantity of porosity, orientation, and pore geometries before any burn-out processes take place to remove the so-called “pore-formers”. A novel freeze-casting and freeze-drying process has been studied to fabricate tubular, anode-supported SOFCs. Freeze-casting followed by freeze-drying was performed by injecting aqueous anode slurries having three varying amounts of water into a temperature- and an atmosphere-controlled mold. The varying amounts of water provided different volumes of ice-formation between the suspended particles during the freeze-casting process, thereby changing the total amount of porosity after the ice was sublimed from the structure. The freeze-casted SOFC anode tubes contained radially-aligned, plate-like pore channels, thus enhancing the gaseous diffusion in the radial direction of the tube’s wall from the fuel channel to the anode-electrolyte interface of the SOFC. Complete electrochemical single cells were prepared on top of this structure using Ni and scandium-yttria-stabilized zirconia (ScYSZ) as the anode functional layer (AFL); a 20 micron-thick, dense ScYSZ coating as the electrolyte; a composite cathode-electrolyte functional layer made of ScYSZ and a popular perovskite material, lanthanum strontium cobalt iron (LSCF); followed by an LSCF cathode layer. Single-cell tests showed the electrochemical performance and associated overpotentials as a function of total anode porosity and were compared to other recent efforts. Additional properties were measured including mechanical strength and permeation of gas flow of the bare anode supports and supports with the AFL.

Bio: Mr. Benjamin Emley is currently a graduate student in Dr. Yan Yao’s group in the department of Electrical Engineering and Texas Center for Superconductivity at University of Houston.

Scanning tunneling microscopy study of the possible topological surface states in MBE grown Ag_2Se

Samira Daneshmandhi

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Abstract: Topological surface states (TSSs) are a class of novel electronic states that are of potential interest in quantum computing or spintronic applications. Unlike conventional two-dimensional electron states, these surface states are expected to be immune to localization and to overcome barriers caused by material imperfection. The formation of spin-textured metallic edge states in Topological Insulators (TIs) enables highly coherent charge and spin transport, making them promising for spintronic applications.

Epitaxial layers of β-Ag_2Se nanostructures, a new class of 3D TIs, were synthesized using molecular beam epitaxy (MBE) method using elemental Ag and Se sources. The growth was combined with in situ high energy electron diffraction (RHEED). High-temperature single stage growth regime was adopted to fabricate Ag_2Se layers. As confirmed by the scanning tunneling microscopy (STM), the surface of Ag_2Se layers consists of closely spaced nanometer sized islands with dimensions

dependent on the growth time on which thin films grow well in an island growth mode. Based on atomic-resolution STM images, a new monoclinic structure is proposed for the MBE grown Ag_2Se film, which was not seen in this system before. As shown by STM analysis, the Ag_2Se layers possess two different monoclinic and orthorhombic crystal structures with the majority of monoclinic structure. It was further shown that (111) plane of the orthorhombic structure always coexists with the (001) plane of the monoclinic structure providing a bold atomic pattern due to their height difference. The electronic structure of both coexisted atomic structures of the Ag_2Se have been investigated by means of scanning tunneling spectroscopy (STS). To test the unique feature of TSSs, we have used STM to examine Ag_2Se surface states and to measure their reflection by and transmission through atomic steps. This study can provide valuable insight into their exotic electrical properties and may allow their possible applications for spintronics and quantum information applications.

Bio: Samira Daneshmandhi is currently a graduate student in Dr. Ching-Wu Chu's group in the department of Physics and Texas Center for Superconductivity at University of Houston.

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Persons with disabilities who require accommodations to attend this seminar should call 713-743-8213.