

T_cSAM Bi-Weekly Brown Bag Seminar

Texas Center for Superconductivity and Advanced Materials



Prof. Alex Ignatiev

Distinguished University Professor of Physics, Chemistry,
and Electrical and Computer Engineering.
Texas Center for Superconductivity and Advanced Materials
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“Thin Film Hetero Structure Solid Oxide Fuel Cell”

Thursday, March 24, 2005

Room 102, University of Houston Science Center

12:00 Noon. – 1:00 p.m.

Abstract

A thin film solid oxide fuel cell (TFSOFC) with significantly reduced operating temperature has been developed based on thin film deposition and photolithographic processing. The unique thin film SOFC design incorporates a thin film (<1 micron) oxide electrolyte, deposited on a nickel foil substrate by pulsed laser deposition and MOCVD, and deposition of a micro porous thin film conducting oxide $\text{La}_{0.5}\text{Sr}_{0.5}\text{CoO}_3$ (LSCO) cathode on top of the electrolyte thin film forming the fuel cell heterostructure. The nickel substrate is then made porous (and thus becomes the cell anode) by photolithographic patterning and etching. This thin film SOFC structure results in operating temperatures as low as 450°C, which now allows for the utilization of more standard cell support materials and also results in much reduced thermal stress and thermal degradation. The thin film SOFC has stably operated in a temperature range of 450-570°C, significantly lower than bulk SOFC's, and has yielded a maximum output power density of ~110mW/cm² in that temperature range. The low operating temperatures coupled with the nickel anode also allow for the direct conversion of hydrocarbons, especially methane and methanol without the problem of coking, thus resulting in a true self-reforming SOFC. The thin film character of the thin film SOFC when integrated with thin film interconnects is expected to result in a high power to volume ratio ($\geq 10 \text{ W/cm}^3$), which will be important in a variety of power applications.

Bio

Alex Ignatiev is the Director of the Texas Center for Superconductivity and Advanced Materials and Distinguished University Professor of Physics, Chemistry, and Electrical and Computer Engineering at the University of Houston. He received a B.S. in Physics and Applied Mathematics from the University of Wisconsin and his Ph.D. in Materials Science from Cornell University. His research interests have been focused on advanced thin film materials and device development and surface chemical interactions that form the basis for thin film growth. Recent efforts have been in the development of high performance superconducting oxide thin films and their application to coated conductor superconducting wire development; to the development of advanced thin film oxide resistive random access memory; to the development of oxide optical micro-detectors for implantation into the eye to restore sight, and to the recent development of thin film solid oxide fuel cells. Ignatiev has published more than 280 scientific articles, has 14 patents, is on the editorial boards of three scientific journals, and has been elected to the International Academy of Astronautics.

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