Electrical & Computer ENGINEERING

SEMINAR

THURSDAY
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Scaife Hall Auditorium
Room 125

4:00 PM
Refreshments—3:30 PM

DESIGNING NITRIDE NANOCOMPOSITES FOR SOLID-STATE ENERGY CONVERSION

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Timothy Sands received his Ph.D. in Materials Science at the University of California, Berkeley in 1984. He joined the Purdue faculty in the Fall of 2002 after nine years on the faculty of the Department of Materials Science & Engineering at Berkeley. Professor Sands is presently the Basil S. Turner Professor of Engineering and a member of the Birck Nanotechnology Center, with joint appointments in the Schools of Materials Engineering and Electrical & Computer Engineering.

From 1984 to 1993, Dr. Sands was a Member of Technical Staff, a District Manager, and a research group Director at Bell Communications Research (Bellcore) in Red Bank, NJ. He has published over 200 papers and has been granted 11 patents in the areas of metal/semiconductor contacts, heteroepitaxy, thermoelectric materials, ferroelectric and piezoelectric materials and devices, semiconductor nanostructures, laser processing and heterogeneous integration. Among the most significant of his scientific and technical contributions are i) the understanding of the interface reactions leading to low-resistance, shallow and thermally stable ohmic contacts to compound semiconductors; ii) demonstration of the first stable and epitaxial metal/III-V heterostructures; iii) transfer of the Laser Lift-off process for GaN LED packaging, for which he was a co-inventor, to industry; and iv) leadership of the team that fabricated the first monolithic fluorescence detection microsystems. His present research efforts are directed toward the development of novel nanocomposite materials for applications in solid-state lighting, direct conversion of heat to electrical power, and thermoelectric refrigeration. Dr. Sands is a recipient of the Materials Research Society (MRS) Von Hippel Award for Graduate Student Research and the Robert Lansing Hardy Gold Medal (The Minerals, Metals and Materials Society).

New materials will be necessary to break through today's performance envelopes for solid-state energy conversion devices ranging from LED-based solid-state white lamps to thermoelectric devices for solid-state refrigeration and electric power generation. The combination of two recent materials advances, control of nitride heterostructures, and development of practical "bottom-up" nanofabrication methods, offers several degrees of freedom necessary for designing nanocomposite materials that can eclipse the performance of conventional thin-film devices. Relaxation of elastic mis-match strain at free surfaces in nitride nanorods and nanowires permits a broader range of lattice mis-match and band lineups in coherent nanostructures than is possible in thin film heterostructures. Nitrides also offer a wide range of transport properties and band structures with compatible crystal structures and growth conditions, ranging from insulators (AlN), to semiconductors (InN, GaN and ScN) to metals (TiN, ZrN and VN).

In this talk, I will highlight our recent work in exploiting these degrees of freedom in the design of monolithic phosphor-free white light emitters based on nanorod heterostructures, and metal/semiconductor solid-state thermionic energy converters utilizing nitride metal/semiconductor multilayers.

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For more information:
http://www.ece.cmu.edu/seminar

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