# 2009 Materials Council Seminar Series
## Georgia Institute of Technology

# *Dr. Andrey Voevodin*

Air Force Research Laboratory, Materials and Manufacturing Directorate Thermals Sciences and Materials Branch, Wright-Patterson AFB, OH

## "Thermal Management Material Research for Aerospace"

Tuesday, November 10, 2009
Room 183 – Love Building – 3:00 - 4:00 p.m.


## ABSTRACT

Thermal Management (TM) is critical for today's military systems across all DoD services and is likely to remain so for the future. A new organization, the Thermal Sciences and Materials Branch, AFRL/RXBT, has been formed to address TM challenges of Air Force systems through advanced material solutions. These needs include extremely high thermal fluxes, aggressive operational temperatures, and large onboard generated waste heat — all orders of magnitude different from commercial systems. Air and space systems have the additionally restricted ability for overboard heat rejection. The approach is to understand and utilize thermal sciences to create revolutionary materials for tailored and adaptive thermal interfaces, high-temperature mechanical contacts, advanced coolants, directionally controlled thermal transport, thermal energy storage, rejection and harvesting, thermal load sensing and self-adaptive response.

Scientific efforts are progressing along: *advanced coolants* with extended temperature range and thermal capacity using single and two-phase operation, synthetic chemistry and nanoparticle technology; *tailored and adaptive thermal conductivity interfaces* using inorganic metal-ceramic multilayer thin films, carbon-nanotube (CNT) arrays, polymer-CNT structures, and micro-encapsulated phase change materials (PCMs); *high and directional thermal conductivity materials* using CNTs and carbon fiber composites, carbon and metal foam structures, metal matrix composites, nano and polycrystalline diamond; *thermal energy temporal storage and harvesting materials* using PCMs and thermoelectric layered and composite structures as well as their coupling for PCM recharging; *high-temperature mechanical sliding interfaces* with adaptive tribological response and thermal heat flow control using nanocomposites of ceramic, metal, dichalcogenides, and carbon; *modeling of thermal flow in nanostructured materials* using multiscale MD and FEM computations for thermal material designs. The presentation provides an overview of major research directions for possible connections of branch programs to academia research and industry developmental efforts.


## BIOGRAPHY

Dr. Andrey A. Voevodin, is the Technology Advisor for Thermal Science and Materials at the Air Force Research Laboratory's Materials and Manufacturing Directorate. Andrey received the B.S. degree in metallurgy engineering in 1986 and Ph.D. degree in Materials Science in 1991 from Tula State Technical University, Russia. Andrey held UK Royal Society Associate Fellowship in Hull University, UK in 1993, and had joined AFRL in 1994 as National Research Council associate and later a civilian employee to work on thin film deposition, surface engineering, and tribology. In 2003 he was assigned as a Tribology Group leader in the Materials and Manufacturing Directorate. In 2007, Andrey became the Technology Advisor for a newly formed Thermal Sciences and Materials branch. Andrey is also leading AFRL Thermal Management Strategic Technology Team, which coordinates on thermal management research efforts in AFRL Technical Directorates. His current research areas include nanolayerd, nanocomposite and nanostructured coatings for thermal conductivity control, hybrid plasma thin film deposition technologies, high temperature tribology, and surface engineering of MEMS devices. Andrey has 140 peer-reviewed publications, seven book chapters and a book, as well as four patents and seven inventions in surface engineering and thin film technologies. He provided over 150 conference presentations is engaged in AVS, MRS, STLE professional society activities, organizing technical sessions, symposiums and conferences. He is an Adjunct Professor of Graduate Materials Engineering Department of the University of Dayton, teaching and graduating PhD and MSc students. Andrey has multiple awards from US Air Force for his research, including the USAF Outstanding Scientist of the Year (2004), the Air Force Civilian Achievement Award (2005), Charles Cleary Award for Scientific Achievements (2005 and 2007).

Host: Professor Zhuomin Zhang (ME), 5-4335; zhuomin.zhang@me.gatech.edu

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