SMU Department of Mechanical Engineering SEMINAR

"Thermal Transport in Graphene and Other Two-Dimensional Layered Materials"

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> Friday, April 12, 2013 3:00 p.m. - 4:00 p.m. Location: Junkins 205

Abstract: Graphene and other two-dimensional (2D) layered materials are being employed for fabricating electronic, energy, and other functional devices. The performance of many of these devices is dictated by thermal transport properties of the 2D building blocks. For example, unwanted hot spots found in graphene electronic devices are related to the thermal conductivity and interface thermal resistance of graphene. It has been suggested that the basal-plane thermal conductivity of suspended few-layer graphene and hexagonal boron nitride (h-BN) increases with decreasing thickness, and can exceed the already record-high values of graphite and bulk h-BN. However, these 2D materials are usually supported on a substrate or embedded in a medium for device applications. Hence, the effects of interface interaction on thermal transport in and across 2D building blocks must be understood. Here, we show that the basal-plane thermal conductivity decreases with decreasing thickness of few-layer graphene and h-BN in contact with an amorphous material, as well as bismuth telluride nanoplates with surface oxide. In addition, because internal interface thermal resistance is minimized in ultrathin-graphite foams, the thermal conductivity of the covalently bonded three-dimensional architecture greatly exceeds those of van der Waals-bonded carbon nanostructure networks that have been developed for thermal management.

Bio: Li Shi is a Professor of Mechanical Engineering and Materials Science and Engineering in University of Texas at Austin (UT Austin). He spent close to a decade in combustion research, which resulted in a bachelor degree in Thermal Engineering from Tsinghua University at Beijing in 1991, a master degree in Mechanical Engineering from Arizona State University in 1997, and four-year industrial research experience in between. His invention of micro-devices for studying thermal physics in individual carbon nanotubes earned him a doctoral degree in Mechanical Engineering from University of California at Berkeley in 2001. Dr. Shi investigated thermoelectric cooling as an IBM Research Staff Member for a year before moving to UT Austin in 2002 to build a program at the interface between thermal sciences and materials sciences. He currently serves as the Editor-in-Chief of Nanoscale and Microscale Thermophysical Engineering. His research accomplishments and professional services have been recognized by the CAREER Award from the National Science Foundation in 2003, the Young Investigator Award from the Office of Naval Research in 2004, the ASME Journal of Heat Transfer Outstanding Reviewer Award in 2005, the Myron L. Begeman

Fellowship in Engineering at UT Austin in 2007, and the O'Donnell Award in Engineering from the Academy of Medicine, Engineering, and Science of Texas in 2013.