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臺灣大學應用力學研究所

演 講 公 告

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主 講 人：郝磬副教授

Aerospace and Mechanical Engineering, University of Arizona

講　　題：Manipulating Thermal Transport in Thin Films with Nanopores and Strain

摘　　要： 如附件

主 持 人： 陳瑞琳教授

時　　間： 114年05月06日（星期二）上午10時30分開始

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Manipulating Thermal Transport in Thin Films with Nanopores and Strain

Qing Hao (University of Arizona)

Periodic nanoporous thin films have been extensively studied for their potential applications in thermoelectrics, heat waveguides, thermal cloaks, thermal diodes, and heat imaging. This talk will address several important issues for the corresponding thermal studies. Firstly, the observed in-plane thermal conductivity (k) reduction was attributed to diffusive pore-edge phonon scattering or coherent phonon transport within a periodic structure (*i.e.*, phononic effects). Approaches to justify the importance of phonon coherence will be discussed. Secondly, nanoporous patterns other than periodic circular nanopores deserve more attention. Here we will emphasize periodic nanoslot patterns that provide more flexibility to tune the in-plane thermal anisotropy of thin films. The narrow neck between adjacent nanoslots can introduce a ballistic thermal resistance to lower the k value along the direction perpendicular to nanoslots, while keeping a much higher k along the direction parallel to nanoslots. For thin films or two-dimensional structures, such nanoslot patterns can be used to improve the thermoelectric performance or extract the in-plane phonon mean free path distribution. New applications of nanoporous thin films will be discussed, *e.g.*, thermal cloaking as the thermal counterpart for optical invisibility cloaks, and an ultra-high heat transfer coefficient for device cooling applications. Finally, the strain dependence of in-plane thermal conductivity (k) in Si thin films has been measured as an alternative approach to tuning the k value.

About the Speaker

Qing Hao received his B.E. degree in Thermal Engineering from Tsinghua University, China, in 2001. He then obtained his M.S. degree from the University of Texas at Austin in 2004, and his Ph.D. degree from the Massachusetts Institute of Technology (MIT) in 2010 under the supervision of Prof. Gang Chen, both in Mechanical Engineering. He spent a year as a postdoctoral research associate in Prof. Gerbrand Ceder's group at MIT, primarily working on novel Na-ion batteries. In Aug. 2011, he became an Assistant Professor in Aerospace and Mechanical Engineering at the University of Arizona and was promoted to Associate Professor in 2017. His current research efforts include thermal transport inside Li-ion batteries, power electronics, boiling and condensation, thermoelectrics, measurements and engineering applications of graphene and other two-dimensional materials. He is the recipient of the R&D 100 Award, AFOSR YIP Award, NSF CAREER Award, JSPS Invitational Fellowship, and the Craig M. Berge Dean's Fellowship at the University of Arizona.