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Temperature-dependent thermal transport in holey silicon nanostructures investigated by impulsive stimulated thermal scattering RYAN DUNCAN, ALEJANDRO VEGA-FLICK, ALEXEI MAZNEV, Department of Chemistry, Massachusetts Institute of Technology, ZHENGMAO LU, LINGPING ZENG, JIAWEI ZHOU, JEAN-PHILIPPE PERAUD, EVELYN WANG, GANG CHEN, Department of Mechanical Engineering, Massachusetts Institute of Technology, KEITH NELSON, Department of Chemistry, Massachusetts Institute of Technology — Nanostructuring of semiconductor materials provides a promising means for the decoupling of their electronic and thermal conductivities, making such systems of great interest to the fields of thermoelectrics and microelectronics. Prior investigations indicated that Brillouin zone-folding and phononic band-gap formation may play a role in the diminished thermal conductivity observed in such structures, although it is unclear to what degree such effects manifest themselves over different temperature ranges. We investigate thermal transport properties as a function of temperature for a series of nanoporous silicon membranes using impulsive stimulated thermal scattering (ISTS)—a non-contact optical technique for measuring in-plane thermal transport. Measurements were carried out at temperatures ranging from 350 to 84 K on samples with pore diameters of 130 nm and pitch sizes ranging from 150 to 500 nm. Monte Carlo simulations for phonon transport were performed for comparison to experimental observations. We will discuss the experimental and computational results, and attempt to determine whether the experimental data are consistent with the diffuse boundary scattering model in which phononic crystal effects are absent.

Ryan Duncan
Massachusetts Inst of Tech-MIT

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