Abstract Submitted
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Influence of nanoscale structure and phonon mean free path spectrum on thermal transport probed using tabletop coherent extreme ultraviolet light[1] J. L. KNOBLOCH, J. N. HERNANDEZ-CHARPAK, T. D. FRAZER, B. ABAD, JILA - Univ of Colorado, WEILUN CHAO, E. H. ANDERSON, LBNL, K. M. HOOGEBOOM-POT, D. NARDI, H. C. KAPTEYN, M. M. MURNANE, JILA - Univ of Colorado — As advances in nanofabrication push the characteristic dimension of nanosystems deep into the nano regime ($\ll$100nm), transport and other properties are often modified compared to bulk materials. However, our ability to fabricate nanosystems has outstripped our ability to characterize them. We have developed a nanometrology technique using tabletop high harmonic coherent extreme ultraviolet beams with wavelengths (10-30nm) and pulse durations ($\approx$10fs) that are well matched to the intrinsic length and time scales of functioning nanosystems. Previously, we observed both size- and spacing-dependent deviations from expected bulk thermal transport away from periodic arrays of nanolines. We found that collective phonon transport can counteract the decreased heat dissipation efficiency due to quasi-ballistic transport when the nanostructure spacing approaches the phonon mean free paths in the substrate. In this new work, we explore nanoscale thermal transport and validate our collective transport models by separately varying the linewidths and periodicities of both 1D and 2D nanostructure arrays on different substrates. Using effective theories and Boltzmann transport equation calculations, we analyze these experimental findings and compare them with new and existing models.

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