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**Anisotropic Deviations from Fourier's Law in Si and MgO and the Importance of Temperature-Profile Extrema** RICHARD WILSON, DAVID CAHILL, University of Illinois — Efforts to engineer thermal conductivity values by alloying, doping, or nanostructuring rely on a fundamental understanding of phonon-phonon and phonon-defect scattering. However, experimentally resolving phonon dynamics remains challenging. Recent studies demonstrate that time-domain thermoreflectance and frequency-domain thermoreflectance are sensitive to the mean-free-paths of heat-carrying phonons. The sensitivity of both techniques relies on the failure of Fourier theory when important length-scales of the temperature-profile become shorter than phonon mean-free-paths. However the correct interpretation of these experiments remains unclear. To address this issue, we characterize the relationship between the failure of Fourier's law, phonon mean-free-paths, important length-scales of the temperature-profile, and interfacial phonon scattering by performing extensive time-domain thermoreflectance experiments on Si, $Si_{0.99}Ge_{0.01}$, boron doped Si, and MgO crystals between 40 and 300 K. We find the failure of Fourier's law causes anisotropic thermal transport in Si and MgO despite cubic symmetry, and that in situations where Fourier's law fails, interfacial phonon scattering can affect the heat-current away from the interface.

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