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Direct optical probing of non-equilibrium thermal transport length scales in hexagonal boron nitride SEAN SULLIVAN, KEVIN OLSSON, ANNIE WEATHERS, ELAINE LI, LI SHI, University of Texas at Austin — The Fourier's law for diffusive heat conduction loses significance for thermal transport over small scales, especially in materials whose thermal conductivity is predominated by low-energy carriers with long mean free paths. One such example is the two dimensional (2D) layered compound hexagonal boron nitride (h-BN). h-BN achieves a fairly high in-plane thermal conductivity contribution from acoustic phonons and their weak interaction with high-frequency optical branches. We study the non-equilibrium thermal transport over submicron length scales in bulk hBN using combined micro-Raman and Brillouin light scattering (BLS) spectroscopies as temperature sensors for the optical and acoustic phonons, respectively. A focused laser acts as a small heating spot on the sample, coupling strongly to high frequency optical phonons. If the length scale of the heating zone is smaller than the distance over which the hot optical phonons give up their energy to lower frequency acoustic phonons, the optical phonons remain out of equilibrium with respect to the other phonon populations. Simultaneous measurement of both acoustic and optical phonon populations over these small length scales provides insight into the non-equilibrium spectral transport processes at play in this high thermal conductivity material, which is actively sought after for heat spreading applications in novel nanoelectronic devices where such length scales become important.

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