Abstract Submitted for the MAR17 Meeting of The American Physical Society

Phonon Propagation Imaging Dynamics in Germanium Nanowires using Ultrafast Pump-Probe Microscopy ERIKA VAN GOETHEM, CHRISTOPHER PINION, EMMA CATING, JAMES CAHOON, JOHN PAPANIKOLAS, Univ of NC - Chapel Hill — We have directly imaged the phonon dynamics in individual germanium nanowires (Ge NWs) using ultrafast pump-probe microscopy with high spatial and temporal resolution to observe excited state transient decay kinetics. A femtosecond laser pulse impulsively excites the lattice, launching acoustic waves which appear in suspended Ge NWs as coherences in the transient decays. We measured the coherence period for a range of NW diameters (25-300 nm) and noticed a linear increase in coherence period with increasing NW diameter. Comparing this trend to an elastic isotropic cylinder we conclude that Ge NWs display a fundamental radial breathing mode (RBM). We observed the RBM propagating along the NW by using spatially-separated pumpprobe. In this mode of operation a pump pulse excites the NW at one spot and a probe pulse detects the arrival of phonons at another location. By varying the spatial separation between the pump and probe, we see the RBM propagate at least 2.5 um along the NW in 2 ns. We also observe the appearance of a low frequency longitudinal mode at large spatial separations (2-4 um). This mode propagates at least 4 um along the NW at 6700 m/s (nearly the speed of sound in Ge), while the RBM spreads approximately 6 times slower than the longitudinal mode.

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Date submitted: 11 Nov 2016

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