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Time-Resolved Diffraction Studies of Nanoscale Thermal Transport MATT HIGHLAND, BRYAN GUNDRUM, YEE KAN KOH, VICTOR ELARDE, JAMES J. COLEMAN, DAVID G. CAHILL, University of Illinois Urbana/Champaign, DON WALKO, ERIC LANDAHL, Argonne National Laboratory Advanced Photon Source — One of the major considerations in fabricating devices on ever smaller length scales is thermal management in nanometer sized structures. Studying thermal transport requires a temperature measurement accurate on short time scales and sensitive to temperature changes in nanoscale structures. Time Resolved X-ray Diffraction (TRXD) utilizes 100ps x-ray pulses as a probe of lattice expansion and ultrafast laser pulses as a pump for the measurement of optically excited materials. Thermal expansion due to laser heating can therefore be used to study thermal transport in thin films. Reported here are (TRXD) measurements of the temperature rise in $(\mathrm{InAs})_x(\mathrm{GaAs})_{1-x}$ thin films due to laser heating. These results are compared with continuum model predictions of temperature rise based on film parameters measured independently using Time Domain Thermal Reflectance. This comparison shows a continuum model is inadequate in predicting the thermal behavior these films on short time scales and is indicative of complex transport phenomenon.

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