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Thermal transport in thin films measured by time-resolved grazing-incidence x-ray diffraction[1] D.A. WALKO, Advanced Photon Source, Argonne National Laboratory, Y.-M. SHEU, University of Michigan, M. TRIGO, D.A. REIS, SLAC National Accelerator Laboratory and Stanford University — Depth- and time-resolved x-ray diffraction were used to study thermal transport across single crystal Bi films grown on sapphire, to determine the thermal conductivity of the films and the Kapitza conductance of the interfaces. Ultrafast Ti:sapphire laser pulses heated the films; x-ray diffraction measured the subsequent lattice expansion. Use of grazing incidence geometry provided depth sensitivity with the x-ray angle of incidence near the critical angle, in contrast to symmetric Bragg geometries which only measure the average temperature of the film. The shift of the film's Bragg peak position with time was used to determine the film temperature, averaged over an x-ray penetration depth that could be selected by choice of the angle of incidence. Films that were thick compared to the laser penetration depth exhibited a large temperature gradient at early times; in this case, measurements with the incident angle below and above the critical angle were more sensitive to the film conductivity and Kapitza conductance, respectively. For thinner films, however, cooling was dominated by the Kapitza conductance on all accessible time scales.

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