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Separation of Joule Heating and Peltier Cooling via Time-Resolved X-Ray Di?raction in Si/SiGe Superlattice[1] MICHAEL KOZINA, MATTHIAS FUCHS, JIAN CHEN, MASON JIANG, Stanford University PULSE Institute, PICE CHEN, PAUL EVANS, University of Wisconsin-Madison Department of Materials Science and Engineering, BJORN VERMEERSCH, JE-HYEONG BAHK, ALI SHAKOURI, University of California-Santa Cruz Department of Electrical Engineering, DALE BREWE, Argonne National Lab, DAVID REIS, Stanford University PULSE Institute — We present detailed measurements of the thermal pro?le in a pulsed current SiGe-based thermoelectric micro-cooler. The evolution of heat ?ow in thermoelectric materials has been previously studied using time-domain thermore?ectance imaging; however, such methods are typically only sensitive to the surface temperature of the device, and the heat ?ow into the material remains hidden. Using time-resolved x-ray di?raction, we probe the transient temperature change in both the surface gold electrode and the underlying Si/SiGe superlattice using the shift in diffraction pattern caused by thermal expansion. We are also able to resolve Joule heating vs. Peltier cooling taking place in the gold through separation of timescales made possible by the relatively short duration (100ps) of the Advanced Photon Source.

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