Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Picosecond Time-Resolved Strain Rosette at Atomic Length Scale MARIA I. CAMPANA, G. JACKSON WILLIAMS[1], DePaul University, SOO HEYONG LEE, Korean Research Institute of Standards and Science, DONALD WALKO, Argonne National Laboratory, ERIC LANDAHL[2], DePaul University — Ultrafast optical absorption in a crystalline solid generates coherent motions of strain, which propagate through the bulk at the speed of sound. Energy relaxation dynamics of the excited lattice system and the subsequent transport properties of the strains have been actively studied. Recently, these high-speed transient dynamics have been studied using laser based pump-probe techniques and time resolved x-ray diffraction (TRXD). However, the interpretation of these studies always assumes a uniaxial spatial profile for the strain (i.e. strain is exerted only along the direction of surface normal of the sample). This assumption comes from a symmetry argument originally given by Thomsen: if the illuminated area of the pump laser beam on the sample surface is much larger than the optical penetration depth, strain gradient along surface normal is expected to be much steeper than along lateral direction, and therefore, the strain generated is usually assumed to be one dimensional. While this assumption simplifies the analysis of the data, (and makes possible such applications as picosecond ultrasonics for the in-situ measurement of semiconductor heterostructure thickness), it overlooks any physical processes that take place along transverse direction. Here we report the experimental generation and detection of the transverse component of the impulsively generated strain in a single GaAs crystal using TRXD. Our analysis is based on a strain rosette applied to three non-collinear Bragg reflections.

[1]Present affiliation: University of California, Davis
[2]To whom correspondence should be addressed

Maria I. Campana
DePaul University

Date submitted: 09 Nov 2012 Electronic form version 1.4