A study of Laser-Generated Strain Fields with Coherent X-ray Diffraction Imaging and Microdiffraction.

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Abstract.

In its 324-bunch mode of operation, the Advanced Photon Source (APS) allows new femtosecond (fs) laser pump/x-ray probe experiments to be developed. In this mode of operation, if one uses the tightly focused low pulse energy (nJ), high-repetition-rate fs-laser Ti:Sapphire oscillator on beamline 7ID, every laser and X-ray pulse can be temporally delayed with respect to each other, as the frequency of the laser oscillator and the x-ray bunches are both 88 MHz. This can result in a high repetition rate pump-probe experiment which uses X rays from every bunch. This presentation describes an example of how coherent X-ray Imaging and Microdiffraction experiments may be used to study laser-generated strain fields in semiconductors. With an oscillator beam focused to 7 micron onto GaAs, we have observed coherent X-ray diffraction patterns with a high-resolution camera. We have also studied the strain fields with a focused x-ray beam generated by a long-working-distance Fresnel zone plate. Results from the two x-ray techniques will be compared. These experiments may help to develop techniques that will be used at the future Free Electron Laser sources where coherent and pump-probe experiments can be done simultaneously.