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Dynamic Convergent Beam Electron Diffraction

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The dynamic transmission electron microscope (DTEM) has been very effective for performing imaging and selected area diffraction experiments with nanosecond-scale time resolution on a variety of systems [1]. The accurate determination of temperature during DTEM and other *in situ* TEM experiments can be extremely challenging. Observations of phase transformations, such as melting, have been used to estimate and calibrate temperatures in DTEM experiments [4, 5].

The DTEM has recently been used to perform convergent beam electron diffraction (CBED) on single crystal silicon and sapphire. The CBED patterns resulting from a single 15ns electron pulse show high order Laue zone (HOLZ) deficiency lines, as would be seen in conventional electron microscopy (see Figure 1). Since HOLZ lines may be used for precise determination of lattice parameters [2,3], the technique is being developed for the DTEM as a means to determine temperature changes caused by laser-induced heating during *in situ* experiments. While HOLZ lines are not expected to be visible at high homologous temperatures (approaching the melting temperature), quantitative CBED offers a means to measure temperature changes during *in situ* experiments for more modest temperature rises (or during the cooling process) by measurement of changes in lattice parameters [6]. It may also offer a route to measurement of lattice strains brought about by internal and imposed stresses during *in situ* mechanical testing.

In this presentation the experimental procedure to obtain dynamic CBED patterns is described. In addition, the image processing routines used to extract quantitative information from the CBED patterns will be discussed.

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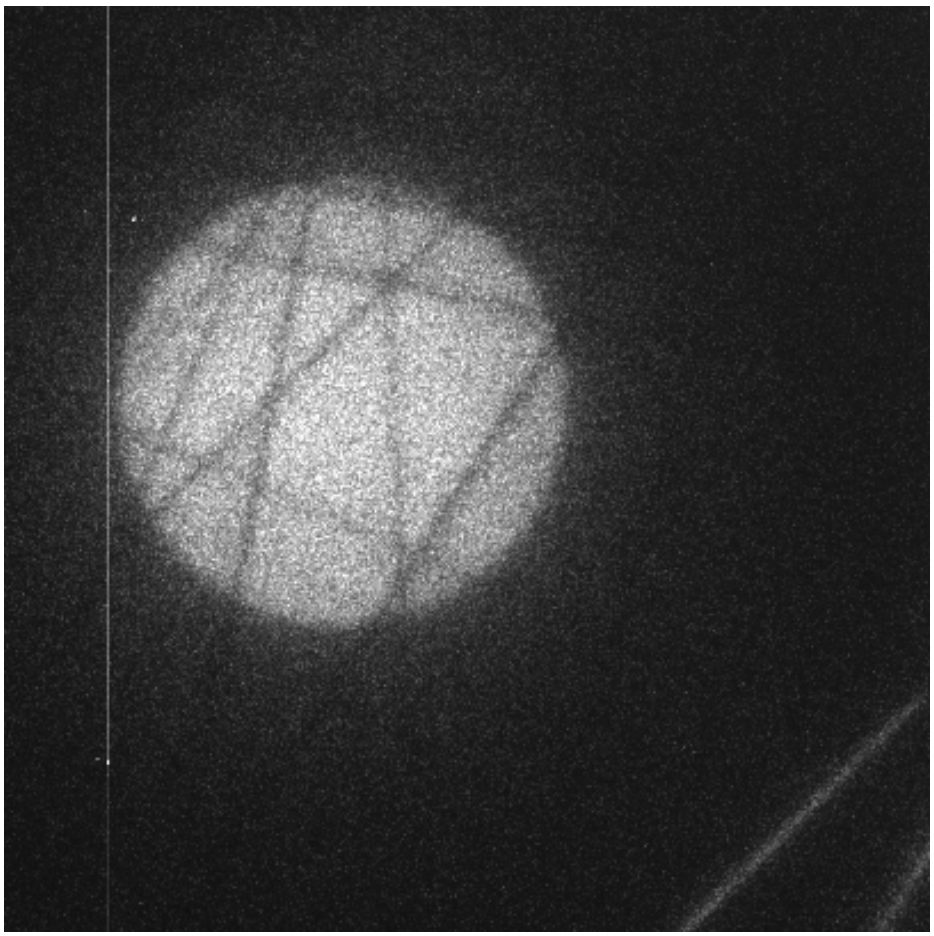

FIG. 1. Convergent beam electron diffraction from silicon taken with a single 15 nanosecond electron pulse using the dynamic TEM at Lawrence Livermore National Laboratory.

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