Applying the dynamic transmission electron microscope to study the a to b phase transformation in Ti

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We have built a dynamic transmission electron microscope (DTEM) at LLNL that is capable of 1.5 ns pulsed electron beam operation with 10^7 electrons per pulse. The electron pulse is created through photoemission at the cathode with 213 nm wavelength laser irradiation. A second, specimen drive laser has been brought incident onto the specimen in order to stimulate it into a desired state. This treatment laser has a pulse duration of 80 ns FWHM and power up to several hundred mJ per pulse. We seek to study complex transient phenomena *in situ* by applying this high time resolution technique to fast, dynamic events in materials science. We have used specimen drive pulses of a few μJ to heat specimens of Ti into the b phase field and observed their structural transformation with pulsed electron diffraction. We have demonstrated dynamical image contrast formation in the DTEM for the first time. We have also demonstrated a spatial resolution of approximately 20 nm in imaging mode.

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