EXAFS Measurements of Laser-Shocked Vanadium and Titanium: The dynamics of material response to shock loading has been extensively studied in the past. Recent studies (mostly using x-ray diffraction) have tried to understand the shock-induced deformation and structural changes at the microscopic level. Laser-generated shocks can be employed to broaden these studies to higher pressures (~1 Mbar) and strain rates (~10^7 to 10^8 s^{-1}). Extended x-ray absorption fine structure (EXAFS), using an OMEGA laser–imploded target as an x-ray source, has been shown to yield the properties of laser-shocked metals on a nanosecond time scale.[1] EXAFS spectra depend on the compression (through the modulation frequency) and on the temperature (through the decay rate of the modulations as a function of photon energy above the *K* edge). The measured EXAFS of vanadium shocked to ~0.4 Mbar yielded the compression and temperature in good agreement with hydrodynamic simulations and shock-speed measurements. Figure 1 shows the analysis of the V EXAFS spectra by fitting the FEFF8 EXAFS code.[2] In laser-shocked titanium at the same pressure, the EXAFS modulation damping is much higher than warranted by the predicted temperature increase. As shown in Fig. 2, this is due to the α-Ti→ω-Ti crystal-phase transformation, known to occur below ~0.1 Mbar for slower shock waves. Thus, the FEFF8 calculation assuming the ω-Ti phase gives a much better fit to the data than assuming the α-Ti phase. In the ω-Ti phase, the nearest atomic neighbors are not equidistant; this gives rise to the beating of different EXAFS frequencies; hence, a faster decay of the modulation is observed. EXAFS detection of crystal-phase transformations is novel and may be important in future studies of laser-shocked materials.

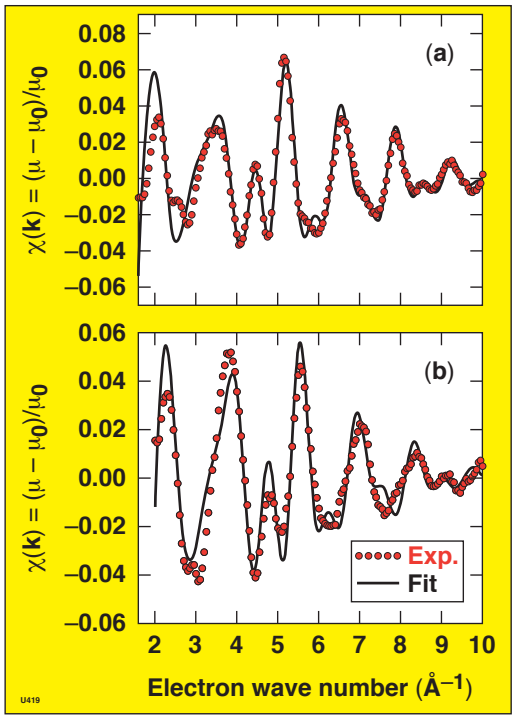

Figure 1. Fitting the measured V EXAFS spectra for the unshocked case (a) and the shocked case (b) with the FEFF8 code, which allows for multiple electron scattering. The fitting yields the temperature and compression of the shocked vanadium.

National Laser Users' Facility (NLUF) Proposals for FY05 and FY06: A record number of 16 proposals were submitted to DOE for NLUF grants for FY05 and FY06. A total of 77.5 OMEGA shot days were requested for the two years compared to the 24 days presently available for NLUF experiments. The NLUF Steering Committee reviewed these proposals on 14 June 2004 and has forwarded its selection recommendations to DOE for approval and action.

OMEGA Operations Summary: During the month of June, a total of 113 target shots were conducted on OMEGA (88 for LLE and 25 for LANL). The LLE experiments included shots for the cryogenic target, DDI, ISE, SSP, LPI, and RTI campaigns. A week-long scheduled maintenance period took place during the second week of June. During the first three quarters of FY04, a total of 1,161 target shots were taken on OMEGA.

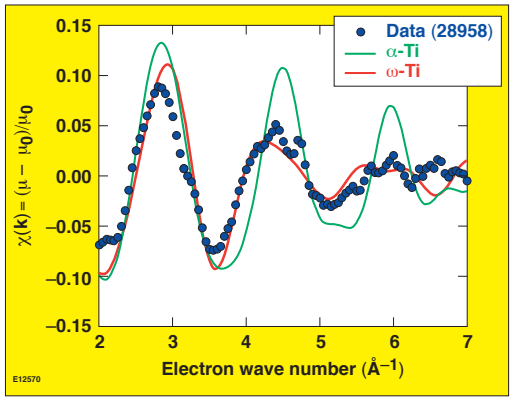

Figure 2. Fitting the FEFF8 EXAFS code to the measured Ti EXAFS spectrum assuming the α-Ti phase (the *hcp* phase at normal conditions) and the ω-Ti phase. Only the compression was adjusted (to fit the modulation frequency) and the *LASNEX*-predicted temperature T = 900 K was assumed. A phase transformation α-Ti→ω-Ti is clearly indicated by the data.

1. B. Yaakobi, F. J. Marshall, T. R. Boehly, R. P. J. Town, and D. D. Meyerhofer, J. Opt. Soc. Am. B **20**, 238 (2003).
2. J. J. Rehr, R. C. Albers, and S. I. Zabinsky, Phys. Rev. Lett. **69**, 3397 (1992).

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