Photo-induced Phase Transition Dynamics in VO_2 probed by Femtosecond X-rays

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Transition metal oxides often exhibit non-trivial correlations between structural and electronic degrees of freedom. Thus, ultrafast measurements of phase-transition dynamics in these materials must encompass probing of both, atomic motion and carrier dynamics.

In this talk, I will discuss the case of VO_2, a non-magnetic oxide undergoing concomitant monoclinic-to-rutile and insulator-to-metal transitions at 340 K[1]. The nature of the low-T phase of VO_2 has been heavily debated in the past[2,3], the issue being the role of structural distortion (Peierls) and electronic correlations (Mott-Hubbard) in determining its insulating properties. Also, the photo-induced version of this transition is accompanied by a large non-linear optical response and is likely to follow a different physical pathway than the strongly first-order, temperature driven, ground-state transformation.

I will report on femtosecond x-ray diffraction experiments performed at *UC San Diego* using short pulses of Cu-K_α fluorescence from a laser-produced plasma. A sub-picosecond, long-range structural transition is observed upon intense optical excitation of the low-temperature insulator[4].

I will then elaborate on the new possibilities offered by the availability of tunable, femtosecond x-ray pulses at the *Advanced Light Source*[5] for this particular problem. Simultaneous measurement of NEXAFS and EXAFS on the femtosecond timescale are proposed as a means of correlating the insulator-to-metal transition with short-range structural dynamics, with particular respect to the roles of V-V and V-O distortions.

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