Photoinducing the hidden M2 phase in VO_2

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We used time-resolved x-ray diffraction at the Advanced Photon Source to study photoinduced structural phase transitions in a 170-nm-thick VO_2 film grown on sapphire (1,0,-1,0). Heating the unstrained film from room temperature induces the well-known phase transition from the monoclinic (M1) phase directly to the high-temperature tetragonal rutile (R) phase [1,2]. In contrast, upon ultrafast optical excitation, the phase transition depends strongly on the laser intensity. At low fluences, the film is partially transformed into the monoclinic M2 phase, a phase which generally is observed only in doped or strained materials. But at fluences above a threshold, a portion of the film is transformed into the M2 phase, decaying on a time scale of a few nanoseconds, while the majority of the film is transformed into the R phase which can persist for tens of nanoseconds. Using "time-slicing" techniques [3] to achieve temporal resolution shorter than the 80-ps bunch duration of the APS, we find the M2 phase grows concurrent with the photoinduced decay of the M1 phase, but the growth of the R phase is delayed by several 10s of ns.

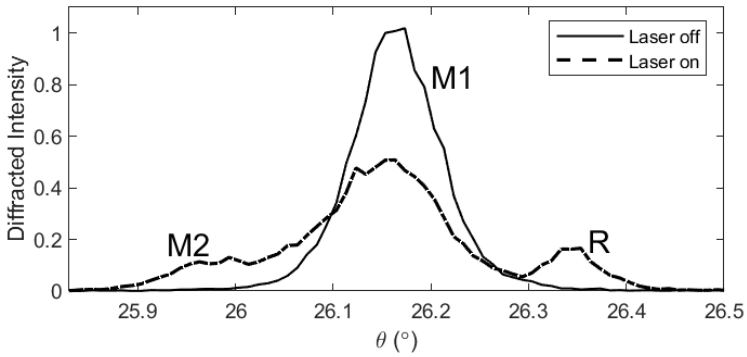

Figure 1: Rocking curve of VO_2 before and 1.1 ns after laser excitation. The change in diffraction intensity represents the change in structure, with the phases as labelled. At this time point, the M2 phase is decaying and the R phase is growing.

References:

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