Dynamic Pathways in
Multidimensional Landscapes

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Photoinduced Lattice Dynamics in BiFeO3 monitored by Femtosecond X-ray Diffraction

Content :

BiFeO3 had a deep impact in the field of multiferroics, since it is magnetic and ferroelectric at room temperature, opening a wide field of applications, e.g. for spintronics and memory devices which can be addressed both magnetically and electrically. Furthermore, it is highly desirable to photo-control the polarization and magnetization in BiFeO3 directly by ultrafast optical excitation.
Here we use femtosecond laser pulses with a photon-energy of 3.1eV (λ = 400nm) to excite a 40nm BiFeO3 thin film above its band gap of 2.8eV. Ultrafast X-ray diffraction (UXRD) at a laser-driven Plasma X-Ray Source (PXS) is applied to follow the photoinduced lattice dynamics on a sub-picosecond timescale. We observe a sound velocity-limited evolution of the strains in the excited BiFeO3 within 10ps indicating an instantaneous stress, which further decays on a ns time scale. From the considerable Bragg peak broadening we can conclude that the photovoltaic origin, driving the ultrafast lattice dynamics, has an inhomogeneous spatial distribution for early (fs) as well as late (ns) time scales after excitation, which is a direct evidence for trapped charges in the thin film.

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