Ultrafast photostriction in devices based on piezoelectric thin films

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Among ferroic materials, ferroelectric oxides are particularly promising due to their numerous functional properties and their potential coupling. Manipulating and integrating these functionalities in devices can pave the way for innovative oxide-based electronics. Photostriction, described as a combination of both photovoltaic and inverse piezoelectric effects, is a complex physical mechanism inducing non thermal strain under illumination. Recent studies in ferroelectric thin films have reported photo-induced strain in the picosecond time range [1-4], thus opening a new route for ultrafast strain engineering and optical actuation in devices. However, the polarization is usually in as-grown state, so its contribution on the photostrictive response is not well understood.

Ultrafast studies have been conducted on photo-induced strain in ferroelectric thin films based devices with an in-situ control of the polarization state. Our time-resolved x-ray diffraction studies performed at Advanced Photon Source (APS) revealed that both magnitude and sign of strain can be controlled by the polarization state, giving a better understanding of the ultrafast photostriction mechanism in ferroelectric devices.

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