**Second harmonic-induced ultrafast wrinkle formation in two-dimensional material**

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Abstract text: The precise control of wrinkles and strain gradients in two-dimensional (2D) materials is of significant interest due to their profound influence on electronic band structures and spin states. However, the mechanisms underlying ultrafast strain modulation, particularly those involving high harmonic phonons, remain poorly understood. Here, we employ ultrafast electron diffraction (UED) to investigate the picosecond-scale dynamics of laser-induced bending in 2H-MoTe₂ thin films. Under laser excitation, coherent acoustic waves are generated within the nanofilm. Owing to the sample thickness exceeding the laser penetration depth, inhomogeneous excitation leads to the emergence of both fundamental (21GHz) and second harmonic (42GHz) acoustic phonons. The experiment and simulation reveal that the second harmonic directly induces a strain gradient along the c-axis, which, via the Poisson effect, transforms into in-plane strain. This nonuniform in-plane strain serves as the primary driving force for film bending. This study not only demonstrates ultrafast laser-based control of internal strain gradients but also provides new insights into the mechanisms of laser-induced bending mediated by coherent phonons, particularly the second harmonic [1-2].

[1] Xiaodong Wang, Yongzhao Zhang, et al. Second Harmonic-Induced Ultrafast Wrinkle Formation in Two-Dimensional Material[J]. *Chin. Phys. Lett.*, 2025, 42(4): 047201.

[2] Yongzhao Zhang, Shuaishuai Sun, et al. Inhomogeneous excitation-regulated coherent strain wave in 2H-MoTe2 revealed by ultrafast electron microscopy. *Phys. Rev. B*, 2023, 108(24): 245426.