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Ultrafast Photoacoustic Phenomena in Transition Metal Dichalcogenide Thin Flake

Controlling acoustic phonons has been attracting attentions since they can carry sound and heat. The recent development of femtosecond laser technology has provided a new route to optically generate and control acoustic phonons in the picosecond (10^{-12} s) time regime. Particularly, when the size of the medium is comparable to the optical pulse width, i.e. on the nanometric scale, the acoustic resonance causes the standing waves and characteristic vibrations in GHz regime. Here we investigate the photoinduced phononic phenomena in thin-flake transition metal dichalcogenide (TMD) VTe_2, by focusing on the charge-density-wave (CDW) coupled to an anisotropic trigonal-monoclinic structural phase transition. For detecting the ultrafast lattice dynamics, we utilize the pump-probe time-resolved electron microscope and diffraction, recently developed by combining the short-pulsed laser with the photocathode electron sources [1,2]. The measurements on the thin-flake VTe_2 reveal the generation and propagation of unusual acoustic waves associated with the optically induced CDW dissolution. Our results highlight the possibility of photo-induced structural transitions in TMD thin flakes as the source of coherent acoustic waves.

References

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