THZ FIELD GENERATION AND MANIPULATION BY COHERENT CONTROL OVER PHONON-POLARITONS

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Abstract

Mixed polar lattice vibrational and electromagnetic modes, called phonon-polaritons, which propagate at light-like speeds through their host crystals are unique and powerful sources of THz radiation. One way to excite them is by non-resonant impulsive stimulated Raman scattering using femtosecond laser pulses. New techniques in spatiotemporal imaging and spatiotemporal and spatial-only femtosecond pulse shaping and structuring of crystal materials have been developed to enable versatile spatiotemporal coherent control over the propagating phonon-polaritons and thereby over the associated THz fields.

Here we present experimental demonstrations of coherent control over phonon-polaritons and the associated THz fields by employing spatial-only, temporal-only, and spatiotemporal pulse shaping to steer, focus, and amplify the propagating THz fields. In addition, we show that spatial-only control allows for the generation of specific excitation profiles, including circular excitation geometries that lead to focusing and increased peak amplitude/intensity levels. The polariton host crystals may be uniform or may be patterned into waveguide, resonator, polaritonic bandgap, and other structures. The capabilities enable multiplexed solid-state THz signal generation, signal propagation among specified addresses, signal manipulation, and signal readout, all without loss of bandwidth.

Applications of our results include programmable generation of user-defined THz waveforms, nonlinear THz frequency spectroscopy, and THz-bandwidth signal processing applications.