Coherent Phonon Excitation in Opaque Nonpolar Materials

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The coherent excitation of vibrational modes in a solid by ultrafast optical pulses is a sensitive probe of the coupling of electronic excitations to vibrational motion. For a number of years there have been two competing descriptions of this process in nonpolar, absorbing materials – the DECP theory of Zeiger *et al*. and the TSRS theory of Merlin *et al*. In the DECP theory the vibration is directly coupled to the laser-excited carrier distribution, while the TSRS theory describes the coherent excitation as a Raman process. In this talk I discuss how an extension of the TSRS theory serves to unify both theories. This new description is then compared to experimental results from a variety of coherently excited vibrations in nonpolar, absorbing materials, including Te, Bi, Sb, Si, and Ge. Data from our laboratory on coherent excitation of the optic phonon in Si will be used to illustrate experimental aspects of this topic.