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Ultrafast Dynamics of Quasiparticle Formation in Structurally Tunable Materials[1]

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Localization of electronic states as a result of electron-phonon coupling plays a critical role in determining the properties of a wide range of materials: polaron formation has a profound impact on charge transport properties of electronic materials, and formation of self-trapped excitons, or exciton-polarons, dramatically changes optical properties and energy transport mechanisms. I will present time-resolved studies of the dynamics of the localization process, focusing on the formation and evolution of self-trapped excitons and polarons. The experiments are carried out in quasi-one-dimensional materials in which the strength of the electron-phonon coupling that drives the dynamics can be systematically tuned by varying the material composition. Our studies use a combination of ultrafast time-resolved techniques that are sensitive to the electronic, vibrational, and structural dynamics that accompany self-trapping, including femtosecond optical spectroscopy in the vibrationally impulsive limit, time-resolved terahertz spectroscopy, and time-resolved x-ray spectroscopy.

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