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Dynamics of photoexcitations in quasi-one-dimensional systems¹

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Low dimensional materials, and in particular, quasi-one-dimensional systems have attracted considerable interest owing to their unusual electronic properties. In many of these systems, strong electron-phonon couplings can lead to the formation of nonlinear excitations such as self-trapped excitons and polarons, in which electronic excitations become localized as a result of their interaction with the lattice. I will present the results of femtosecond time-resolved experiments in which we have studied the dynamics of the formation and evolution of localized excitations in quasi-one-dimensional molecular solids. This work has been carried out on mixed-valence halide-bridged transition metal linear chain (or MX) complexes, a class of materials that serve as model systems for the physics of low-dimensional materials. In these complexes, the relative strengths of the electron-electron and electron-phonon interactions, the fundamental physical parameters that determine the properties of the excitations, can be systematically tuned by chemical substitutions in the chain structure. Using femtosecond vibrationally impulsive excitation techniques, we have studied the coupled electronic and vibrational dynamics associated with excitonic self-trapping in a series of quasi-one-dimensional structures, and using time-resolved THz techniques, we have studied the dynamics of the formation and subsequent evolution of polarons.

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