

Ultrafast Dynamics and Interactions of Molecular Vibrational Polaritons

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Molecular vibrational polaritons are hybrid half-light, half-matter quasiparticle. This hybrid quasiparticles not only inherit properties of both photons and matters, but also processes unique new photonic and molecular phenomena, including tilting chemical potential landscapes of reactions, adding new energy transfer pathways and strong photonic interactions. Many of these developments hinge on fundamental understanding of its physical properties of molecular vibrational polaritons. Using pump probe and 2D IR spectroscopy to study vibrational-polaritons, we obtained results that advance both polariton and spectroscopy fields. I will discuss a few phenomena of IR molecular vibrational-polaritons due to their delocalization and hybridized nature: 1. Cavity-enabled intermolecular energy transfer and inter-cavity interactions, and 2. Intermolecular nonlinear interactions between polaritons resides in neighboring cavities, along with some other phenomena. These results will have significant implications in novel infrared photonic devices, lasing, molecular quantum simulation, as well as new chemistry by tailoring potential energy landscapes.