DYNAMICS OF COPPER PHTHALOCYANINE MOLECULES INSIDE AN OPTICAL CAVITY REVEALED BY TWO-DIMENSIONAL ELECTRONIC SPECTROSCOPY (2DES)

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Polaritons are hybrid light-matter states that can be created by placing a molecule inside an optical cavity due to strong coupling between confined electromagnetic modes and optical transitions of the molecule, and can have different energies, coherence, and vibrational characteristics than the bare molecules outside of the cavity. The strong coupling results in new physicochemical properties of the hybrid system including their reactivity or charge and energy transfer characteristics and has recently gained significant research interest. We have used two-dimensional electronic spectroscopy (2DES) to study the dynamics of the copper phthalocyanine (CuPc) molecules placed inside an optical cavity. The 2DES is a powerful tool to investigate excited state dynamics that enables a direct correlation between excitation and detection energies of the system with ultrafast time resolution. We compare the dynamics of the CuPc molecules that are inside an optical cavity with that of the bare molecules outside the cavity under similar experimental conditions to understand how the optical cavity modifies the excited state dynamics of the molecules. The coupling between light and the optical transition of the material inside cavity can be controlled by changing the incident angle of the light. We demonstrate this by repeating 2DES experiments on a cavity sample at normal and 75 degree incidence of the pump pulse. The results show that the presence of an optical cavity can significantly modify the excited state dynamics of the molecules and enhance the coherence.