New organic photovoltaic materials studied with pump probe and two-dimensional electronic spectroscopy

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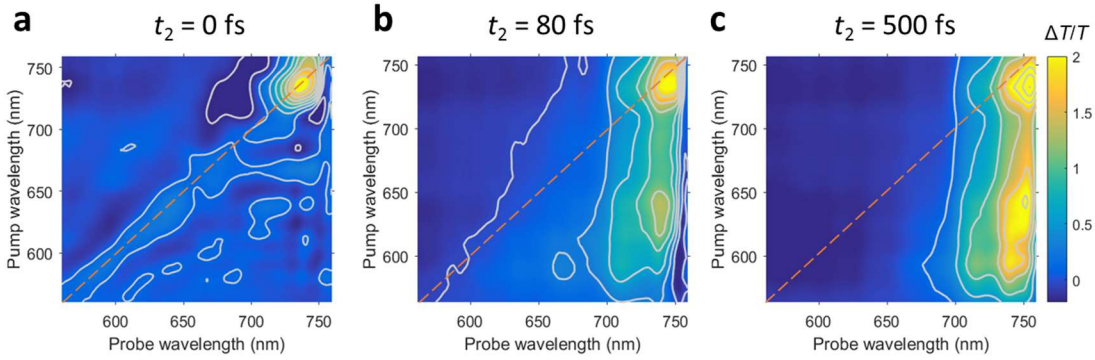
The field of organic photovoltaics is flourishing with the development of new materials with ever more desirable properties for economically viable devices. In particular, hybrid perovskite semiconductors have proved extremely promising for high-efficiency solar cells [1], while bulk-heterojunction materials based on pi-conjugated polymers have benefitted from the use of non-fullerene acceptors [2,3]. Studying the photophysics of such materials on an ultrafast time scale helps to reveal the functioning mechanisms of different devices, thus providing valuable insight regarding new design strategies. In this work we present a summary of our group's recent results on such systems employing narrowband and sub-10 fs pump probe, as well as two-dimensional electronic spectroscopy (2DES) on different spectral ranges [4]. In lead iodide perovskites we used 2DES to resolve a sub-100 fs ultrafast thermalization of free carriers, along with its fluence and excess energy behavior [5]. For pi-conjugated polymers with non-fullerene acceptors we report a systematic study comparing the dynamics between pristine materials and blends. This allows us to describe in detail the processes of exciton splitting, polaron formation and polaron dynamics.



2DES of lead-iodide perovskite at 0, 80 and 500 fs. The amplitude growth at low pump and high probe wavelength reveals ultrafast carrier thermalization.

References:

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