Deciphering Carrier Dynamics in Polycarbonate Following Excitation with Ultrashort Laser Pulses

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Polymers exposed to ultrashort pulsed lasers (UPL) experience a range of physical and chemical changes that play a key role in applications ranging from material processing to advanced photonics, and biomedicine. A theoretical model developed for dielectric materials is extended to describe the, previously, unexplored excitation and carrier dynamics for PC while femtosecond Transient Absorption Spectroscopy is used to elucidate the evolution of the material's response and ultrafast dynamics. Interpreting the experimental measurements using the theoretical model suggests the existence of an energy level that facilitates the formation of self-trapped exciton metastates between the conduction and valence bands (approximately 2.4-2.8 eV below the conduction band). It also predicts the electron-plasma lifetime (around 110-150 fs), the recombination time (about 34 ps), and the non-linear part of the refractive index due to Kerr effect (with n_2 values ranging from 1.1-1.5×10^{-16} cm^2/W). The results are expected to support future efforts aimed at elucidating how intense ultrashort laser pulses interact with polymeric materials which is crucial for optimizing the manufacturing processes of these materials for potential applications.

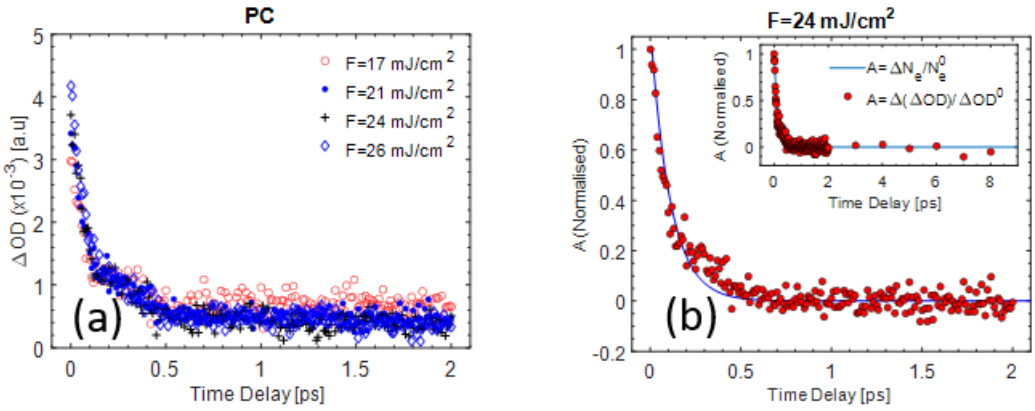

Figure 1: Evolution of optical density for PC (at 785 nm) photoexcited at 1026nm (a) with various pump fluences for various fluences (illustrated at time delays Δt<2 ps). Relaxation of optical (filled *red* circles) and carrier density (*blue* solid lines) in PC under photoexcitation at F=24 mJ/cm^2.

Acknowledgements: This work has partially funded from Horizon Europe, the European Union's Framework Programme for Research and Innovation, under Grant Agreement No. 101057457 (*METAMORPHA*).