

Polydienes solutions and soft matter non linear optics

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I will present the phenomenology of an unexpected case of light matter interaction in polymer solutions. When irradiated by red laser light, transparent non-absorbing viscous polydienes solutions respond by a local variation of refractive index, that is due to a local change of concentration.

Remarkably, both local refractive index increase and reduction can be observed upon irradiation, depending on the solvent environment. Macromolecules can either be selectively attracted or repelled by visible laser light, independently of the optical contrast between the polymer and the solvent. Local increase of refractive index induces self focusing and the formation of fibre like structure. Different patterning can form including soliton-like single fiber, multi-filament arrays (related to modulational instabilities), as well as gratings. The local decrease of refractive index leads to a different type of patterning. Though the nature of the coupling between light and material remains elusive, long irradiation lead to irreversible crosslinks between polymer chains.

The versatile light-polydiene coupling, qualitatively different from electrostriction mechanism, may open new ways for macromolecular manipulation and micro-patterning by optical fields. Various possibilities as to the origin of the coupling will be discussed.