Transition from saturable absorption to reverse saturable absorption of carmoisine dye under low-powered continuous wave laser excitation

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Abstract

Unique nonlinear optics (NLO) properties i.e. intensity-dependent nonlinear absorption and refraction of carmoisine (food dye) is studied using a single beam z-scan technique. A switchover behavior from a saturable absorption (SA) to reverse saturable absorption (RSA) is observed by increasing concentration of carmoisine dye. The flip in the absorption response is attributed to the aggregated dye molecules under intense laser beam, which induces the formation of carmoisine dimers. In the UV-Vis absorption analysis, the appearance of two bands at higher concentration confirms the formation of carmoisine dimers. Fourier transform infrared spectroscopy (FTIR) suggests the intermolecular charge transfer (ICT) within the naphtyl-azo bonds. Huge magnitude of chi((3)) is calculated in the order of 10(-5) esu due to ICT process within the dye molecules. Optical limiting (OL) behavior is observed with low OL action threshold 0.01 kW/cm(2) under continuous wave laser beam. The experimental findings shows that carmoisine dye has potential as an optical material for photonics applications such as an optical limiter under low-powered continuous wave laser.

Keywords

Author Keywords: Carmoisine; Optical limiter; Optical switching; Z-scan technique; FTIR

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