Third-order Optical Nonlinearities of Higher Fullerene and Carbon Nanotube

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Recent theoretical and experimental studies on the third-order optical nonlinearities of higher fullerenes including C_{70}, C_{76}, C_{84}, C_{86}, C_{90}, C_{94} and C_{96} are briefly reviewed. The extended Su-Schrieffer-Heeger model is introduced and applied to study the third-order optical nonlinearity of chiral carbon nanotubes (CCN), where the average contribution Γ of one carbon atom to the third-order optical nonlinearity of each CCN is calculated and compared with that of a well characterized polyenic polymer. It is found that (i) the smaller the diameter of a CCN, the larger the average contribution Γ; (ii) the metallic CCN favors larger third-order optical nonlinearity than the semiconducting one; (iii) CCN can compete with the conducting polymer achieving a large third-order optical susceptibility. Also the doping effect on the second-order hyperpolarizability of a tubular fullerene is investigated. It is found that the doping effect increases greatly the magnitude of the second-order hyperpolarizability of tubular fullerene.

Key words: Optical Susceptibility; Hyperpolarizability; Sum-over-state Approach; Resonance Enhancement; C_{60}; Higher Fullerene; Tubular Fullerene; Carbon Nanotube; Chiral Effect; Doping Effect.