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On nonlinear optical constants of polystyrene

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Polystyrene (PS) has found known applications in integrated optics as passive waveguide [1, 2, and 3] and also as active waveguide. with organic dopant like rhodamine 6G [4]. It is transparent in the visible and NIR range and also has an ultralow waveguide loss of 0.1 dB/cm and small birefringence of 4.7×10^{-3} [1, 2, and 3]. Hu et al. [5, 6 and 7] demonstrated an all-optical-switching process in a polystyrene photonic crystal (PC). These reports have stimulated researches on nonlinear optical properties of PS. We performed nonlinear prism coupling to measure the n_2 and α_2 of PS waveguide at 532 nm, and change of the refractive index and absorption coefficient induced by varying the applied intensity. The absorption coefficient and refractive index values at corresponding average guided intensities. Values of n_2 and α_2 which were derived from the linear fitting curves in Fig.1a and b are considered as maximum possible values at 532 nm. Hu et.al. [5] reported that the shift of 5 nm was induced by 18.7 GW/cm^2 which means $\Delta n_{PS}=5/(2\cdot 220)=0.011$ which corresponds to $n_2 = 5.9\cdot 10^{-13}$ cm^2/W. This value is 23 times of the maximum n_2 value of ours. The reason is not fully understood yet. The M_w of their PS is almost 8 times higher than our PS. These facts are observed already as M_w dependence of $\chi^{(3)}$, which are reported elsewhere [8 and 9]. But such a strong dependence on molecular weight is unlikely. We assume that the high repetition rate (76 MHz) of the laser system used by Hu, et. al. [6] could give rise to additional of thermal nonlinearities.

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