Second Harmonic Generation in Hybrid Nanostructured Sol-Gel SiO_2:DR1 films

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To control the long-range order at nanometric level in hybrid films can improve their second-order non-linear optical properties[1]. Amorphous sol-gel SiO_2 films doped with dipolar chromophores have been subject of research for a long time due to their potential photonic applications[2], but the effects of nanostructures in the films have not been completely studied yet[3]. We synthesized SiO_2 films doped with the well known dipolar chromophore Disperse Red 1 (DR1). The films were synthesized by the sol-gel method, they were deposited on microscope slides by spin-coating technique and the chromophores were non-centrosymmetrically oriented by means of a Corona poling field. The films were bottom-up nanostructured through the use of ionic and neutral surfactants. The different kinds of nanostructures present in the films were determined by means of X-ray diffraction (XRD). The lattice parameter of all the nanostructures were in the range of 2.26 nm and 3.89 nm. The second-order non-linear optical properties of the films were mainly studied in resonance by transmission second harmonic generation, but the orientation of the chromophores inside the films was studied too by UV-vis spectroscopy. The second order parameter and the second harmonic generation intensity were studied for each sample as function of the poling time at three different temperatures: 80°C, 100°C and 120°C. The stability in the orientation of the chromophores was also studied at the same three different temperatures. The results were compared to those obtained in analogue films made with PolyMethylMetacrylate (PMMA) as the matrix of the films. It was found that some SiO_2:DR1 nanostructured films were able to generate a second harmonic signal even larger than that signal generated by SiO_2:DR1 amorphous films or by PMMA:DR1 amorphous films. Figure 1 shows the second harmonic generation signal of the films at 120°C as function of the incidence angle of the fundamental beam of light.

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References

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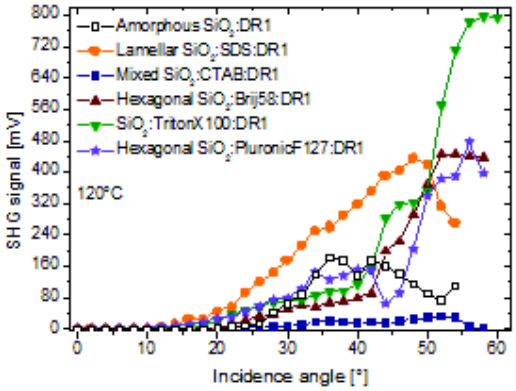
Figures



Second Harmonic Generation signal of the amorphous and nanostructured sol-gel SiO_2:DR1 hybrid films as function of the incidence angle of the fundamental beam of light.