SECOND AND THIRD HARMONIC RESPONSE IN ZNO/PMMA NANOCOMPOSITE FILMS

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In the nanometer regime, various quantum mechanical effects, such as an increase in the band gap of a semiconducting material with a reduction of the size, are observed. Exists the possibility of a continuous tuning of the optical and electronic properties by varying the size of the particles, such materials can be viewed as promising candidates for future applications in the field of catalysis, sensor technology, transistor, electrode materials, logic circuits and laser working [1].

Among them, ZnO shows quantum confinement effects in the experimentally accessible range of sizes (less than 7 nm) [2,3]. Furthermore, ZnO is a technologically important material with widespread use and there has been much interest in synthesizing ZnO nanocrystals of various sizes in the past few years. Concerning its nonlinear optical properties, it shows second and third order optical nonlinear behaviour in crystals and thin films as well as in nanocrystals. Therefore, it is a suitable material for the realization of nonlinear optical (NLO) devices like frequency converters, logic elements in nanoscale optoelectronic circuitry.

The nanoscale crystals (NCs) of ZnO were embedded into polymethylmethacrylate (PMMA) polymeric matrix and nanocomposite films were prepared by modified spin coating method. We have investigated the properties of the ZnO/PMMA nanocomposite films for second and third harmonic generation of picoseconds optical pulses. It has been shown that ZnO NCs at low concentration exhibit high NLO response that decreases with ZnO NCs concentration. Besides, ZnO NCs with higher dimensions are characterized by increased NLO parameters. The effective values of the second and third order nonlinear susceptibilities were estimated to be higher than that of ZnO bulk or film.

The nanoparticles of ZnO embedded into PMMA show quite high second and third order nonlinearity and high resistance to the intensive laser light that make this material very interesting for other investigations and further possible application.

References

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