Study on Composite Organic Nonlinear Optical Materials

March, 1991

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Conjugated organic materials have been attracting attention because of their large and fast optical nonlinearities. In this thesis, first a measuring setup which was able to effectively collect and detect the second harmonic waves generated form organic powder samples was presented. From a study on a series of N-alkyl-4-nitroaniline, a new organic nonlinear materials, N-butyl-4-nitroaniline(BuNA)was found to have a SHG(second harmonic generation)powder efficiency of 14(X urea) and to be phase-matchable, though the efficiency is strongly dependent on the recrystallization solvent. Next, composite films of BuNA and various polymers made in a constant electric field were studied, and a film of BuNA/ polystyrene with thickness of about 3μm showed a SHG intensity of 6. 4 times higher than a urea powder sample with thickness of 1mm in the transmitting, direction. Composite materials of para- nitroaniline(pNA)and its N-alkyl derivatives showed large SHG activities, though the individual compound has weak or no activity. In particular, the activity of the pNA/isopropyl-NA mixture was 1670 times higher than that of urea. This may be due to the crystal growth of noncentrosymmetrical polymorphism of pNA. Finally, composite materials of 2-methyl-4-nitroaniline(MNA)and pNA were studied, changing the mixing ratio. It was found thatthe mixtures show a maximum SHG powder efficiency of 520(X urea)when a mixing weight ratio, MNA/pNA becomes 40. The X-ray diffraction patterns indicated that the enhancedSHG activity of the mixtures may be due to some changes of MNA molecules in the direction of the hydrogen bond. The SHG activity of the mixtures was found to be thermostable and also not to deteriorate for over two months.