An executive summary of the final report of the work done on the, Minor Research Project of UGC entitled "Some Investigations on the Physical Properties of Polymer Doped Organic Materials for Nonlinear Applications" sanctioned by UGC, vide sanction letter No. **MRP(S)/0519/13-14/KAMA002/UGC-SWRO Dated: 15th Feb 2014**

Some Investigations on the Physical Properties of Polymer Doped Organic Materials for Nonlinear Applications

Organic materials exhibiting large third-order nonlinear optical (NLO) coefficients have potential applications in optical switching, optical data storage, processing of information by wavelength multiplexing, modulating the phase as well as frequencies of the optical signal, etc.Among the organic materials, chalcones possess an interesting structure with a π conjugated system through which delocalization of electronic charge distribution takes place, leading to a high mobility of the electron density.Materials having fast response time, high linear transmittance, low limiting threshold etc., show optical limiting property.

Chalcones being organic molecules cannot be used directly in practical photonic device applications because of the possibility of getting degraded or bleached when exposed to intense light. In order to overcome this drawback, chalcones can be doped into a polymer matrix. This enhances the chemical and physical stability of these materials while retaining the NLO properties and linear optical transmittance.

The objectives of the present study are i) to synthesize new NLO materials and to study their crystal structure, thermal, linear, and NLO properties and to establish their structure-property relationship. ii) to embed chalconesinto a polymer matrix and investigate their linear and NLO properties.

In the present investigation, six new materials belonging to chalcone have been synthesized and single crystals were grown. Solubility studies were conducted to select suitable solvents to grow the larger size crystals. The unit cell parameters and structural aspects were determined for three crystals using single crystal XRD. Two of the crystals resulted in triclinic crystal system and the other one has monoclinic crystal system. All of them possess entrosymmetric space group, which discards the possibility of SHG. However, the new chalcones exhibit third-order NLO properties.

The functional groups present in chalcones were confirmed by FTIR spectroscopy. The thermal characteristics of the chalconeswere established from the TGA- DSC analysis. The melting points of these crystals vary in the range of 88.2 °C to 154.07 °C and decomposition temperature vary in the range between 119.02 °C to 508 °C.

The linear optical properties of crystals were determined using UV-Vis-NIR spectrum. The direct and the indirect transition energy was determined. The third-order NLO properties namely nonlinear absorption, nonlinear refraction and optical power limiting studies were employed for the crystals using Z-Scan technique.All chalcone crystals show negative nonlinear refractive index. The real and imaginary parts of third-order nonlinear susceptibility were determined. Ground state absorption cross section and excited state absorption cross section were calculated.

Since organic materials get bleached by the intense laser an attempt is made to dope them into a polymer matrix. Two of the chalcone derivatives were embedded in poly (methyl methacrylate) (PMMA). Chalcone doped PMMA films were prepared at ambient conditions. Linear optical properties and energy gaps were determined. The polymer embedded chalcones exhibited enhanced optical and mechanical properties, making them useful in optoelectronic, optical power limiting and optical switching device applications.

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