ABSTRACT

This work furnishes an over all idea about polymeric materials which are venerated as good candidates for the fabrication of active optical devices. This thesis mainly reflects the synthesis and characterization of rare earth/dye doped polyvinyl alcohol (PVA) and polymethyl methacrylate (PMMA) polymers which are of importance in potential applications like luminescence devices, laser systems, optical switching systems, optical communication components etc. Various techniques like FTIR spectroscopy, TGA/DTA, DSC, Vicker's hardness test, SEM, dielectric spectroscopy, UV-VIS spectroscopy, fluorescence spectroscopy, Z-scan and m-line spectroscopy are used to assess the different properties of these polymer systems.

The spectroscopic parameters of Sm$^{3+}$ ions and Nd$^{3+}$ ions in PVA films are well elucidated in the thesis using Judd-Ofelt theoretical analysis. The lasing characteristics of the Nd$^{3+}$/PVA is also investigated and discussed. It is observed that the PVA films are good candidates as host matrices for rare earth ions in realizing optical amplification and stimulated emission.

The dielectric constant and hardness values of methylene blue doped PMMA matrices are also obtained using impedance analyzer and Vicker's hardness tester. The effect of methylene blue on the glass transition temperature is also discussed with the help of DSC thermograms. The colourimetric studies of different dye doped PMMA matrices which give primary colours red, green and blue are also sketched out. The purity and colour coordinates of these primary colours are also evaluated using CIE 1931 chromaticity diagram. The Z-scan technique is employed to study the nonlinear properties and the values of effective nonlinear absorption coefficient and imaginary part of third order susceptibility are evaluated for these dye doped PMMA matrices.

Keywords: PMMA, PVA, rare earths, dyes, UV-Visible spectroscopy, fluorescence spectroscopy, Vicker's hardness, Z-scan technique etc.