ABSTRACT

In this information age, there is an essential to increase the capabilities of computer and other data processing optical devices for more flexible bandwidth. In every six months doubling the usage of bandwidth in the internet due to the data based networks. All optical switching is one goal of the next generation of photonics research which may make possible the all optical computer. If the switch would perform in optical domain, it is possible to increase the switching speed. At higher intensities, materials are depending on intensity dependent refractive index and absorption. To achieve the optical domain light in the optical fibre should be controlled by another light. So for that effective all optical switching high intensity refractive index is required. This contribution is proportional to the third-order nonlinear optical susceptibility and explains the interest in the topic of this work.

Third order nonlinear optical properties of the materials are related with all optical switching application. There are many reports on third order materials like inorganic, organic and polymers. The large third harmonic generation has been found in polyene type molecules. The delocalized or π- conjugated molecular materials have strong optical nonlinearities and could perform effectively in information processing devices. There are no criteria for the design of appropriate materials with large third order nonlinearities. Therefore, it is still challenging to make high throughput all-optical switching devices responding on the picosecond time scales. Therefore, a major challenge in designing the third order nonlinear optical chromophores is to simultaneously achieve acceptable thermal stability, transparency, nonlinearity and process ability in one compound. In addition to this, the aromatic ring system has incorporated into the molecular chain improves the thermal stability of organic compound.

The main focus of this work is to investigate on third order susceptibility of OH1 malononitrile and cyclododecane derivative crystals for optical switching applications. The nonlinear absorption (NLA) and nonlinear refractive index (NLRI) of the crystals have been studied using Z-scan technique. Thermal nonlinear optical effects in crystalline materials were studied using He-Ne laser. One photon and two photon figure of merit have been calculated for optical switch applications.
In chapter 1, discusses the introduction to nonlinear optics, organic crystals and instrumentation. In chapter 2, explains the synthesis, structure, crystal growth, and morphology studies on the 2-{3- [2-(4-Hydroxyphenyl) vinyl]-5, 5- dimethylcyclo-
hex-2-en-1-ylidene} malononitrile crystal and its derivatives. In chapter 3, discusses studies on linear optical property of malononitrile derivative crystals. In chapter 4, focussed on z-scan construction and studies on nonlinear absorption, nonlinear refractive index of malononitrile derivative crystal for optical switching application. In chapter 5, discusses optical limiting, mechanical, thermal and electronic studies on malononitrile derivative crystals. In chapter 6, studies on linear and nonlinear optical properties of 4-N, N-dimethylamino- 4’-N’-methyl-stilbazolium 2, 4, 6-
trimethylbenzenesulfonate crystal. In chapter 7, studies on linear and nonlinear optical property of cyclododecanone crystals. In chapter 8, gives the conclusion, discussion and suggestion for future work.