Abstract

Chiral materials which form non-superimposable mirror images, have tremendous applications in biology, chemistry, physics, pharmaceuticals, and material science. But these chiral materials exist in two enantiomeric forms and therefore differentiating between them is a big challenge. Broadly, this thesis has made an attempt to differentiate enantiomers with the help of Raman spectroscopy, high pressure techniques and refractive index experiments.

To investigate chiral materials one of the key methods is to observe its behavior by interaction with linear and circularly polarized light. Traditionally circularly polarized light is generated by using a quarter wave plate. Initially, procedure for finding fast and slow axes of a quarter wave plate by correlating interference colours to optical path difference was carried out. Newton's rings experimental setup was then modified to differentiate enantiomers of chiral molecules with the help interference technique and hence refractive indices as a result of circular birefringence.

High pressure Raman spectroscopic study on chirality-inducing compound in quasi-hydrostatic and non-hydrostatic pressure environments was carried out. Chiral compounds are used as active pharmaceutical ingredients (APIs) to make drugs in the pharmaceutical industry. To probe pressure effects on drug molecules, Raman optical activity experiments were performed to collect characteristic details of both enantiomers of chiral molecule under non-hydrostatic pressure.

The present investigation of chiral compounds presents novel, simple and inexpensive technique to study enantiomers of chiral samples. Our findings indicate that small compression of .08 GPa results in switching of the chirality (racemization) of enantiomers. These results are extremely important and beneficial to the pharmaceutical industry as during the tableting process pressure can alter drug's chirality.

The appendix of the thesis contains details of chiral metamaterials on which we did a literature survey and found that chirality can induce negative refractive index properties in the metamaterials and has many applications in making perfect lens, invisibility cloaks, and antennas.