Characterization of Liquid Crystals:

Various techniques have been used to characterize liquid crystals. The main factors to be considered for describing liquid crystalline structure involve their positional, orientational and bond orientational order. By considering these parameters, one can identify the proper phase as well as the interactions between molecules of liquid crystals. For macroscopic view, Polarized Optical Microscopy (POM) is a standard tool in the identification of liquid crystal phases and phase transitions but requires considerable experience, particularly in the studyof new and less familiar materials. In this case, if the polarized light incident on any material has its polarization direction either parallel or perpendicular to the director, it will appear black under crossed polarizers. Since liquid crystals are anisotropic, they cause light polarized along the director to propagate at a different velocity than that polarized perpendicular to the director, then the LC might appear bright under crossed polarizers. The polarization of light is rotated by the LC molecules. Along with POM, X-ray diffraction (XRD) provides a much more definitive means for the identification of mesophases. This technique not only helps to determine the structure of the LC phases but also illustrate presence of long range order. Differential Scanning Calorimetry (DSC)is a helpful technique which complements the optical methods in determining the liquid crystal phase transitions. Grazing-incidence X-ray diffraction (GIXD) is a superior tool to analyze nanostructures in thin films *[Rev.Adv. Mater. Sci. 44 (2016) 398-406]*.

DSC:

It is an inexpensive and rapid method to measure heat capacities of condensed phases. In this technique the difference in the amount of heat required to increase the temperature of a sample and reference are measured as a function of temperature. Both the sample and reference are maintained at nearly the same temperature throughout the experiment. Generally, the temperature program for a DSC analysis is designed such that the sample holder temperature increases linearly as a function of time. Detection of phase transitions

The basic principle underlying this technique is that, when the sample undergoes a physical transformation such as phase transitions (as in mesophases), more or less heat will need to flow to it than the reference to maintain both at the same temperature. Whether less or more heat must flow to the sample depends on whether the process is exothermic or endothermic. For example, as a solid sample melts to a liquid it will require more heat flowing to the sample to increase its temperature at the same rate as the reference. This is due to the absorption of heat by the sample as it undergoes the endothermic phase transition from solid to liquid. Likewise, as the sample undergoes exothermic processes (such as crystallization) less heat is required to raise the sample temperature. By observing the difference in heat flow between the sample and reference, differential scanning calorimeters are able to measure the amount of heat absorbed or released during such transitions. DSC may also be used to observe more subtle phase changes, such as glass transitions. (http://instrument-specialists.com/thermal-analysis-applications/differential-scanning-calorimetry-dsc/)

A representative DSC curve has been shown below: