X-ray diffraction studies of liquid crystalline phase structure

Damian Pociecha

Department of Chemistry, University of Warsaw, Warsaw, Poland
pociu@chem.uw.edu.pl

The x-ray diffraction is a powerful tool not only for investigation of solid crystals but also soft condensed matter, e.g. liquid crystals (LCs). General knowledge about liquid crystalline phases is that they have structure intermediate between solid crystals and liquids, however the meaning of "intermediate" is not always clear. Liquid crystalline phases may not exhibit any long-range positional order – nematic phase, or the positional order is reduced to one or two dimensions – smectic or lamellar (1D) and columnar (2D) phases, respectively. However *zoo* of liquid crystalline phases is much richer than simple *nematic*, *smectic* and *columnar phase*, up to now more than 50 LC phases have been recognized, sometimes differing very subtly in their structure. The x-ray diffraction is often the only method for unambiguous determination of these structures; it also enables studies of critical phenomena associated with phase transitions between LCs phases, which are often of second order. However, the most of the x-ray diffraction studies of LCs utilizes only information stored in diffraction peaks positions which allows for determination of the crystallographic unit cell parameters and their temperature evolution, recently methods analyzing signal intensities were developed that can be used for reconstruction of electron density distribution within the unit cell.

As an example the structural studies of 2D phases formed by strongly bent mesogenic molecules will be presented. Such molecules are known to form lamellar phases with polar ordering, which makes them very attractive from application point of view. Quite often apart from simple lamellar structures their form more complicated phases, formed from layer fragments re-arranged into 2D columnar structures. The rare examples of cubic phases and axially polar hexagonal phases made of bent core molecules will be also discussed.