Liquid crystals as organic electronic materials

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Liquid crystals are interesting materials not only for display application but also electronics application. The nature of self-organizing molecular aggregation of liquid crystals are very important as organic semiconductor materials because the charge carrier transport in organic semiconductors was controlled by the molecular alignment and order. In my tutorial talk, I will show the fundamentals of electronic properties and charge carrier transport in organic semiconductors and overview the research for charge carrier transport properties and organic electronics devices in liquid crystalline materials.

Charge carrier transports in discotic and smectic liquid crystals were mainly investigated by time-of-flight technique. The electronic transport in a columnar hexagonal liquid crystal phase was revealed and the mobility show 10^{-3} cm^2/Vs in 1993.[1] The electronic transport in a smectic liquid crystal material was also showed and the mobility was 10^{-3} cm^2/Vs.[2] For the charge carrier transport in liquid crystals, the purity of material are very important and impurity molecules occurs ionic transport in especially low viscosity liquid crystal phases.[3] Electronic transport was also exhibited in nematic phases of highly purified samples. Furthermore, the polycrystalline thin film *via* liquid crystal phases showed high mobility over 0.1 cm^2/Vs, which indicated the controllable grain boundaries directions by the molecular alignment and anisotropy crystal growth.[4] Otherwise, grain boundary seriously damages charge carrier transport in non-liquid crystalline materials. Thus, liquid crystalline materials can be used in both liquid crystal phase and crystal phases.

I will also talk about liquid crystalline materials for organic electronic device such as organic transistor, organic light emitting diode, and organic solar cells. In organic transistors, the mobility is very important parameter, so crystalline small molecule and conjugated polymer materials are mainly used because the molecular order is high in crystal phases.[5,6] Liquid crystalline materials play an important role in solution fabrication process because it is possible to fabricate uniform thins films via uniform liquid crystalline thin films. The crystal phase of liquid crystalline phenyl-benzothienobenzothiophene derivative showed very high mobility over 5 cm^2/Vs and small variation.[7]

References:

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