

In-Situ X-ray study of the polymerization of liquid crystalline, conjugated oligothiophene derivatives

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Introduction

The performance of field effect transistors (FETs) is to a large extent determined by the properties of the semiconducting layer. Improvements in the performance have not only been achieved by the synthesis of new materials, but also by controlling the morphology of the active layer. The latter is important for two reasons. Imperfections, related to grain boundaries and cracks, have been shown to act as traps, lowering the charge carrier mobility.^[1] Furthermore, research into semiconducting liquid crystals has shown that films with highest molecular ordering also show the highest charge carrier mobilities.^[2]

In recent years increasing attention has been paid to the use of semiconducting oligomers with high charge carrier mobilities as building blocks for semiconducting polymer networks.^[3] During device construction a layer of such a material is applied from solution, after which it is cross-linked to enhance stability, i.e. to withstand solvent deposition of the next layer.

Results

Here, we present our results of the in-situ investigation by small and wide angle X-ray scattering (performed at BM26 and ID11, ESRF) of the polymerization of conjugated thiophene derivatives.

These materials exhibit several liquid crystalline phases. We show that polymerization in an appropriate, high ordered, phase locks in the order, which is then maintained upon subsequent cooling. (Figure 1) The results obtained by SAXS and WAXS were complemented by optical and thermal characterization.

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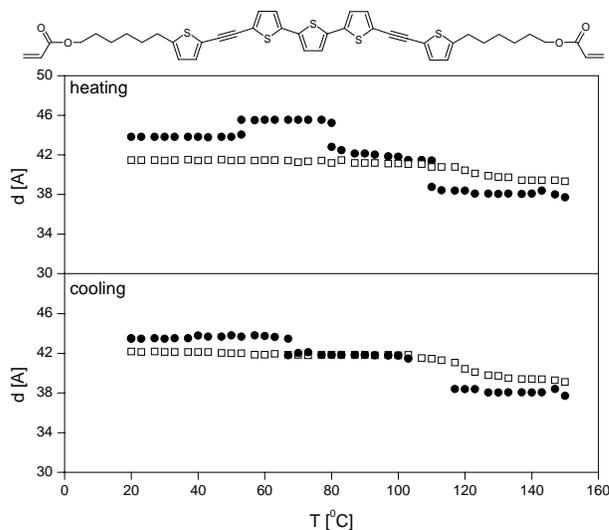


Figure 1: D-spacing ([0 0 l] reflection) as a function of temperature for a sample polymerized at 100 °C (open symbols) and an unpolymerized sample (closed symbols) as determined by SAXS (BM26, ESRF)

References

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