5. Liquid Crystal Templated Spatially-Ordered Conductive Polymers

Conjugated polymers are typically semiconductors. They exhibit the electrical properties of metals or semiconductors and retain the attractive mechanical properties and processing advantages of polymers. Disorder, however, limits the carrier mobility and, in the metallic state, limits the electrical conductivity. Therefore, research directed toward conjugated polymers with improved structural order and hence higher mobility is a focus of current activity in the field.

A novel approach for the synthesis of semi-conductive polymers is the template synthesis of this type of polymers using liquid crystal (LC) materials as hosts for alignment purposes. This liquid crystal templated synthesis method produces a very well aligned conductive polymer manifested from the scanning electron microscopic images of the polymer. The measured conductivity was found to be uniform throughout the whole film, which implies that the pre-existing LC polymer network acts as an ordered template for patterning the resulting conductive polymer at a submicron scale, but also allows it to form a continuous film (more like an interpenetrating polymer network) at a macroscopic scale because of its porous structure.

Figure 1 shows the morphologies of the templated conductive polymers using liquid crystals such as BDH, E44, 8CB and DSCG. As shown in the figure, liquid crystal exert anisotropic force upon these relatively low concentration of pre-polymer, and macroscopically facilitates the monomer molecules to diffuse and aggregate at the polymer active chain ends. As the polymer grows, the PEDOT becomes more hydrophilic. For a liquid crystal molecule that is more polar (E44 and 8CB) or hydrophilic (DSCG), it is easier for the conductive monomer to diffuse longitudinally with respect to liquid crystal molecular orientation, thus polymer fibrils are formed with a higher order along the alignment direction.

![SEM images of template synthesis of conductive polymer](image)

**Fig. 1** The SEM images of template synthesis of conductive polymer prepared with (a) lyotropic nematic DSCG, (b) smectic 8CB and (c) cholesteric 1D pattern.