The role of molecular architecture on ordering in different hierarchic levels in materials for organic electronics

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Charge transport in semiconducting polymers is a key factor for the operation of most organic optoelectronic devices.[1] Although significant progress has been achieved in the design of polymers exhibiting relatively high charge carrier mobilities, the multifaceted relationship between the polymer molecular structure and the corresponding charge transport properties remains a challenging field of investigation. Flexible side groups are generally considered only as fragments serving to improve solubility and prevent crystallization of the material. Using a combination of synchrotron X-ray diffraction with complementary methods of physical characterization such as AFM, DSC and optical microscopy, the critical role of the molecular architecture in the structure formation is shown. Furthermore, the partially ordered side chains can be considered as an effective tool for fine tuning of the supramolecular structure. This approach is illustrated on semiconducting polymers with different molecular structure.

Since the conductivity of organic materials is anisotropic, for their applications is extremely important to be able to control the active layer texture and morphology. The interaction of the active layer with substrate can stimulate the formation of specifically oriented structures, which are different from the bulk.[2,3] Varying the length of the alkyl groups and their topology, layer-like and columnar (including helical) mesophases with desired domain size and orientation can be manufactured. (cf. Figure). The results can help to design new types of active layers with specific charge carrier transport.

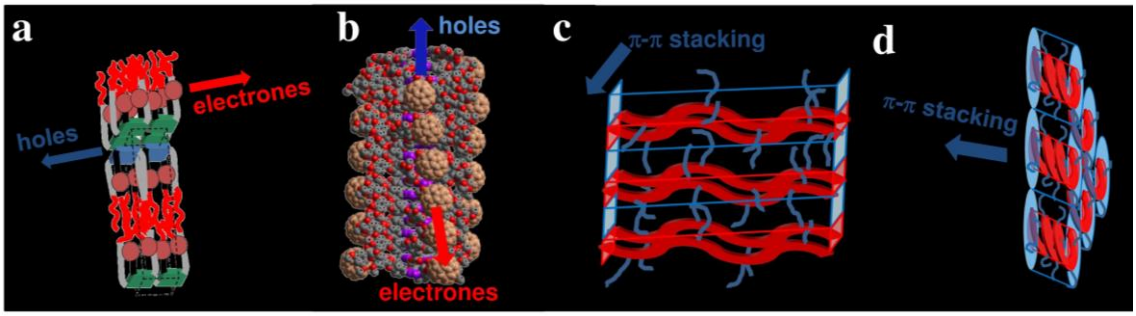

Figure. The effect of the side chains topology on the structure of porphyrin derivatives (a,b) and polythiophenes (c, d).

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