Nanostructured bulk heterojunction devices using donor-acceptor block copolymers

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One of the challenging aspects in designing and developing novel functional materials is to incorporate the desired optical and /or electrical properties maintaining their film-forming and thermal characteristics which make them suitable for thin film device applications. An important criterion for most of the applications in the field of energy research such as photovoltaics, batteries, fuel cells etc. is that these materials should have well-defined nanostructured morphology in thin films in order to be capable of fulfilling the complex functions of charge carrier/ ion transport in confined channels/geometries without adversely affecting the other complementary functions. This morphological control on a nanoscopic level controls the interface between the functional domains as well as the long term stability of such devices. We have demonstrated the chain of control on all length scales -from molecular to mesoscopic to macroscopic- using the self-assembly principle of a fully functionalised block polymer for photovoltaic applications as represented in fig 1.

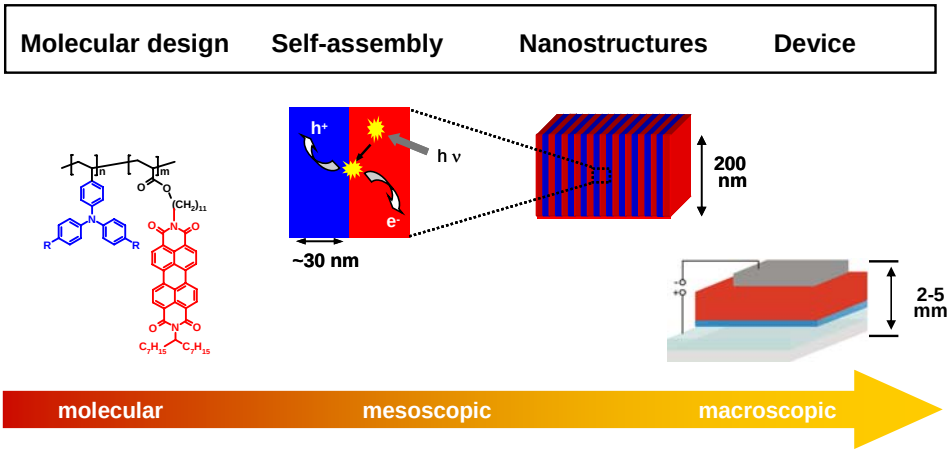

Figure 1.*Schematic representation of the interconnection of molecular structure, morphology and device functions and an example to realize this using tailor-made synthesis and self-assembly of a block copolymer.*

This contribution covers the design, synthesis and properties of some novel block copolymers carrying poly(3-hexylthiophene) segments and perylenebisimide units suitable for photovoltaic applications. Block copolymers those allow the incorporation of semiconductor quantum dots or nanocrystals to get hybrid systems with morphology control will also be discussed. The characterization of these materials in thin films and their application in devices will be presented.

References

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