Synthesis of Conjugated Polymers with Directed Alignment

Technology #5439

University of Michigan’s Method for Directed Alignment of Conjugated Polymers

Researchers at the University of Michigan have developed a method for the directed alignment of conjugated polymers (CPs). CPs are fast emerging as active materials for various optoelectronic applications such as organic solar cells and thin film transistors since they demonstrate highly anisotropic optical and electronic properties such as absorption, emission, and conductivity.

The optoelectronic properties of CPs can be fully realized in device applications only when the conjugated chains are aligned. However, directed alignment of CPs is a very challenging problem. For example, in solution, CPs do not have a planar structure due to the low rotational energy barrier along the conjugated backbone. Therefore, CPs need to be concentrated for good self-organization.

Technical Details

Three important design requirements of CPs have been identified as part of the aforementioned design principle: (1) intramolecular S-F interaction for concentration induced chain planarization, (2) bulky side chains to prevent side chain interdigitation, and (3) carbon with tetrahedral out-of-plane bonding. These features induce chain planarization, self-assembly, liquid-crystal-like good mobility, and enable chain alignment along an applied shear field.

Evaluation of the designed CPs using 2-D grazing incidence X-ray diffraction shows a well-defined CP alignment with a high dichroic ratio of 16.67. Additionally, thin film transistors built using the design principle show a highly anisotropic three orders of magnitude faster hole mobility along the alignment direction, and anisotropic optical gating effects under a polarized light direction.

Applications and Advantages

Applications

- Optoelectronic applications
  - Organic solar cells
  - Thin film transistors
  - Light emitting diodes
  - Optical and amperometric sensors

Advantages
• Concentration-regulated chain planarization
• Self-assembly
• Liquid crystal-like good mobility
• Non-interdigitated side chains
• Chain alignment along an applied shear field

Inventors

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