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Understanding organic materials performance in field-effect transistors

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PURPOSE OF THE ABSTRACT

In the last years, much of our effort has been devoted to the search and study of new high-mobility semiconductors for organic thin film transistors. The approach used for the materials design has been two-fold: (i) the combination of donor and acceptor moieties in the pi-conjugated skeleton, which allows fine tuning of the frontier molecular orbitals, being this necessary for achieving electron/hole or ambipolar transport and ambient stability [1]; and (ii) rational selection of the type and positioning of specific solubilizing substituents ensuring processability [2], which is essential to make these materials scalable to industry.

However, material processability should be attained minimizing a negative effect on charge transport. Therefore, proper energy levels, planar molecular conformations, close intermolecular pi-pi stacking and adequate thin film crystallinity need to be maintained upon alkyl substitution.

In this communication, several examples of molecular and polymeric materials are shown.[3,4] A rational design, guided by experimental and theoretical evidences, has prompted modifications on their conjugated skeletons, donor/acceptor subunits ratio and/or selection of proper alkyl solubilizing chains, which induce noticeable changes in their electronic performances. The main aim of these studies is the basic understanding of charge transport in organic materials. For this end, we will use Raman spectroscopy and DFT quantum-chemical calculations as important tools for materials characterization.

FIGURES

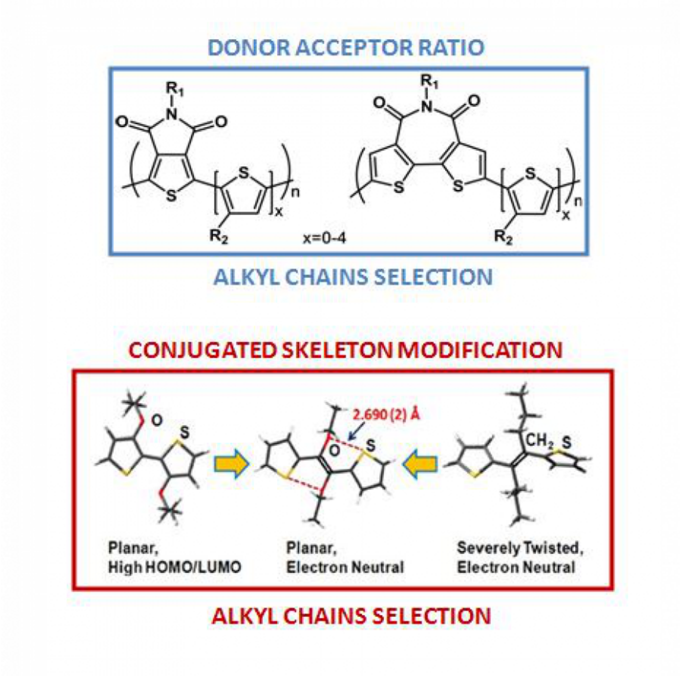

FIGURE 1

Materials selection

Examples of rationally designed polymeric materials for organic electronics.

FIGURE 2

KEYWORDS

Organic field-effect transistors | Rational design | Donor-acceptor semiconductors | Raman spectroscopy

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