Synthesis and characterization of polymeric functional electron donors for electronic applications

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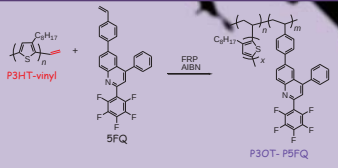
Introduction

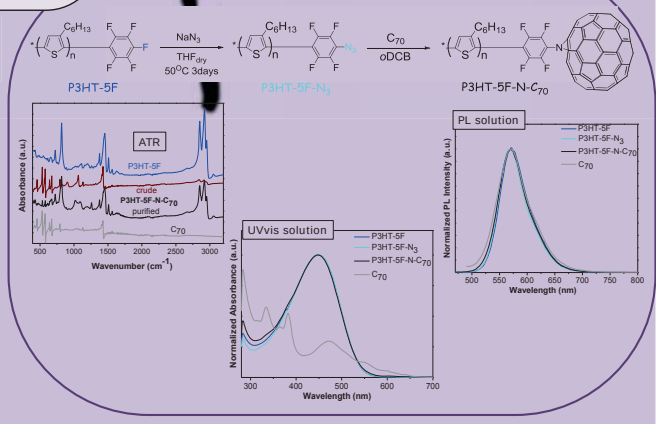
In order to enhance the efficiency of organic solar cells (OPVs), new materials with complex architectures have been developed leading to efficiencies in the order of 12%. Nevertheless, the still most commonly employed system especially for large area devices remains the P3HT/PCBM binary mixture, while more recently significant performance improvements have been reported using low band-gap polymeric electron donors like carbazole-alt-benzothiadiazole copolymers (PCDTBT). A critical issue still troubling the scientific community is the stabilization of the active layer's morphology in the long term. The introduction of a hybrid compatibilizer, bearing both an electron donating polymer and electron accepting fullerene units, has been effectively enhancing the stability of the thin film.

Herein, P3HT or PCDTBT electron donors, are modified with perfluorophenyl or vinylic units. These functionalized semiconductors are then used to create either copolymers having electron donor and acceptor functionalities or to create new hybrid nanomaterials based on carbon nanostructures. More importantly, for the hybrids' case we have developed a versatile methodology of fewer and less complex synthetic steps applicable to all sp^2 hybridized carbon nanostructures. .

Electron donor-acceptor Copolymers

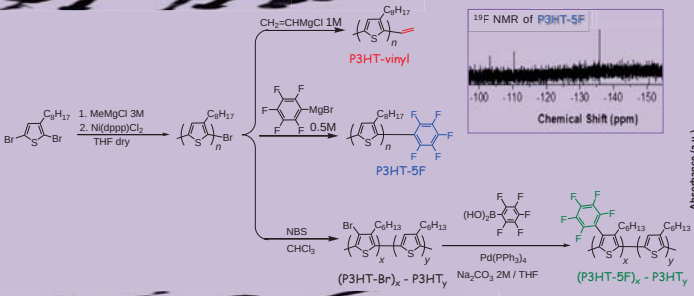


Hybrid P3HT electron donors

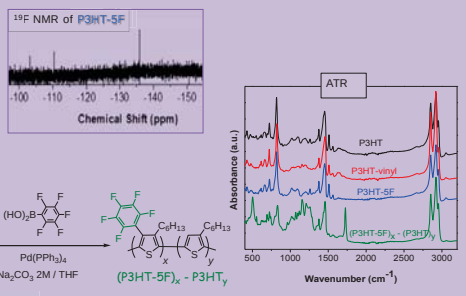


Experimental

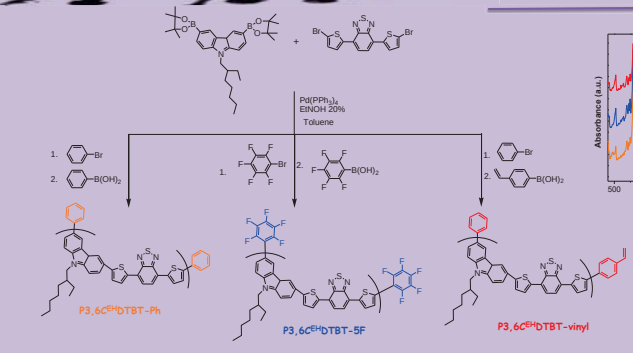
functionalized electron donors



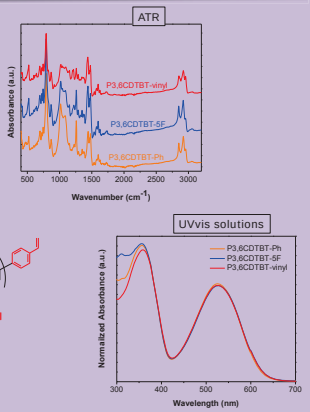
Structural Characterization



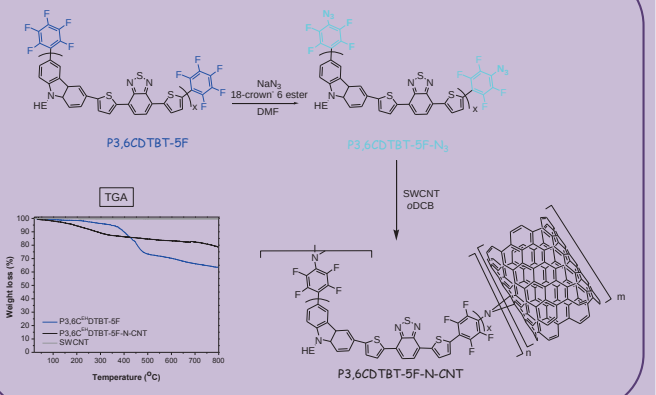
functionalized low band-gap electron donors



Structural & Optical Characterization



Hybrid low band-gap electron donors



Acknowledgments

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References

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Conclusions

✓ Functional vinyl and perfluorophenyl units were successfully introduced onto P3HT or PCDTBT derivatives.
✓ P3HT-vinyl & P3,6CDTBT-vinyl can react as comonomers to create block copolymers.
✓ P3HT-5F & P3,6CDTBT-5F functionalized polymers were successfully transformed into azides and thereafter hybrid semiconducting polymers with carbon nanostructures were created.