Development of hybrid semiconducting materials for organic electronics

Sofia Kakogianni[1], Aikaterini K. Andreopoulou[1,2], Joannis K. Kallitsis[1,2]

[1]Department of Chemistry, University of Patras, Rio GR26504, Greece.
[2]Institute of Chemical Engineering Science Foundation of research Technology Hellas FORTH/ICE-HT, Patras, Greece

http://www.aphnrl.chem.upatras.gr/

Introduction

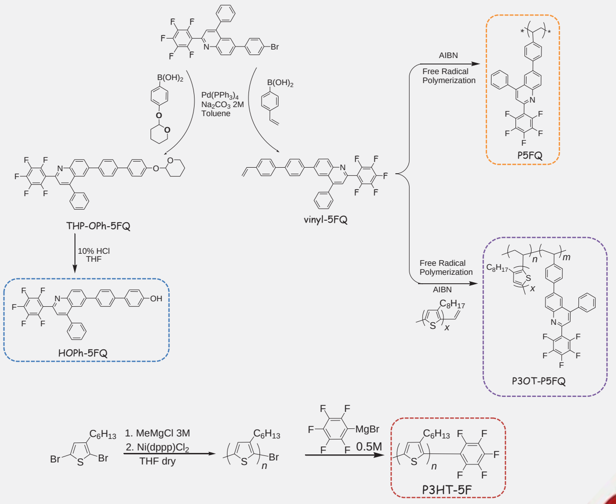
The replacement of fossil fuels by renewable resources is crucial because of the extensive decrease of their supplies and most importantly to avoid the negative effects of their use to the environment. Great attention has been attracted by the conversion of solar energy directly into electricity through photovoltaic devices. Among the various types of photovoltaics, the organic photovoltaics (OPVs) can cover large areas, can be fabricated easily and in low cost, but currently their power efficiencies are still lower compared to the inorganic devices. To optimize the performance of organic photovoltaics novel materials that present combined properties are being developed. New hybrid materials consisting of organic semiconductors and carbon nanostructures and can improve and stabilize the morphology of the thin film, which is the active layer of the photovoltaic device.

Herein, we present the synthesis of perfluorophenyl functionalized organic semiconducting materials (e.g. quinolines, polythiophenes, and donor-acceptor copolymers). The perfluorophenyl unit can be transformed to an azide that, in a second step, performs a [3+2] cycloaddition reaction with the sp^2 hybridized surface of carbon nanostructures producing 1,6-azo bridged hybrid materials.

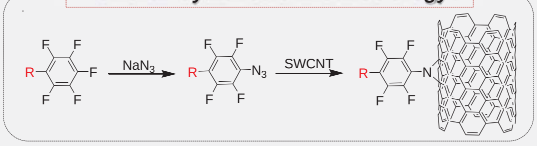
Experimental

Synthesis

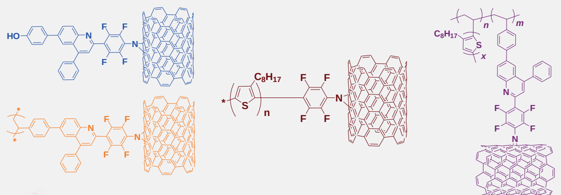
Synthesis of -5F funtionalized Semiconducting materials:



General Synthetic methodology:

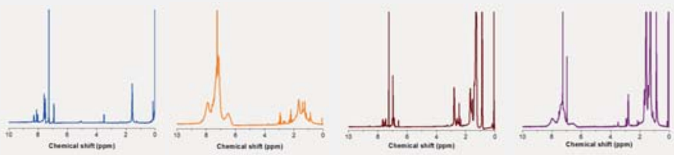


Electron donor/acceptor hybrids:

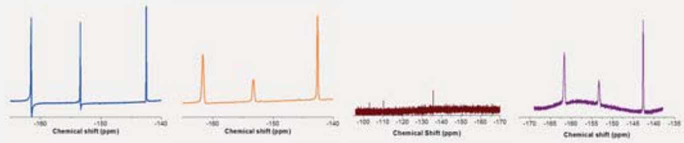


Characterization

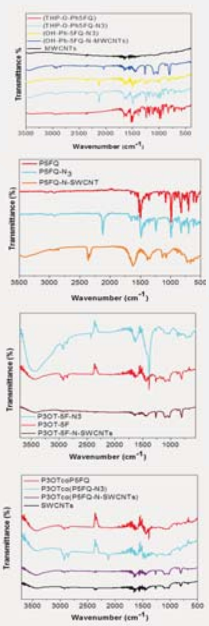
1H NMR



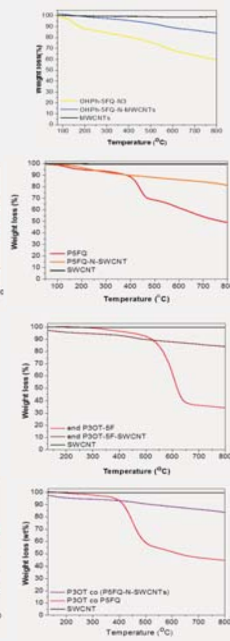
19F NMR



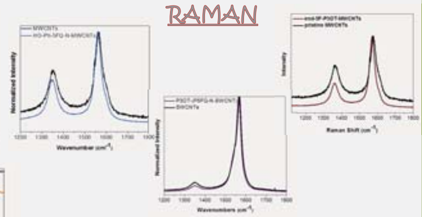
FT-IR



TGA



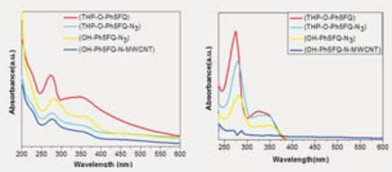
RAMAN



UV-vis

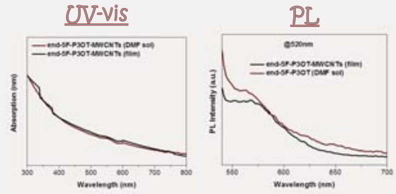
solution

film



UV-vis

PL



References

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2. S. N. Kourkouli, A. Siokou, A. A. Stefopoulos, F. Ravani, T. Plocke, M. Mueller, J. Maultzsch, C. Thomsen, K. Papagelis and J. K. Kallitsis, *Macromolecules*, 2013, *46*, 2590–2598
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Conclusions

✓Perfluorophenyl functionalized electron accepting quinolines, electron donating polythiophenes or electron donor-acceptor copolymers were created.
✓The *para-* fluorine atom was successfully transformed into azide and hybrid materials with carbon nanotubes were synthesized.
✓All hybrid materials present the characteristics of their net counterparts.