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Functional applications of crystalline acenes and heteroacenes

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The ease with which small carbon-rich molecules can be functionalized allows a single chromophore framework to be tuned for use in a myriad of electronic applications. Careful selection of substituents allows tuning of both solubility and crystal packing, which is important for the improvement of both film morphology and charge transport. Additional substituents on the chromophore can be added to improve stability, shift phase transitions, or change the dominant carrier type for the material. Using 4, 5 and 6 fused-ringed acenes and heteroacenes as the chromophore, our functionalization approach has created organic materials for use in high-performance organic transistors and organic solar cells. The crystal-packing arrangements for these two types of devices are dramatically different. This talk will examine how materials with two-dimensional, layered pi-stacking arrangements yield high-performance transistors, and how subtle tuning of the substituents can further improve performance. In the case of bulk heterojunction organic solar cells, substitution of the acene chromophore with small electron-withdrawing groups yielded effective acceptors in blends with polythiophene donors. In this case, materials with strong pi-stacking interactions yielded the poorest-performing solar cells, while those with weak, 1-dimensional pi-stacking interactions yielded the best performance.

The subtle interplay between the native characteristics of the carbon-rich chromophore and the changes in intermolecular coupling afforded by fine-tuning crystal packing become a powerful tool for optimizing acene-based materials for a wide variety of applications.

EVERYONE IS WELCOME!
