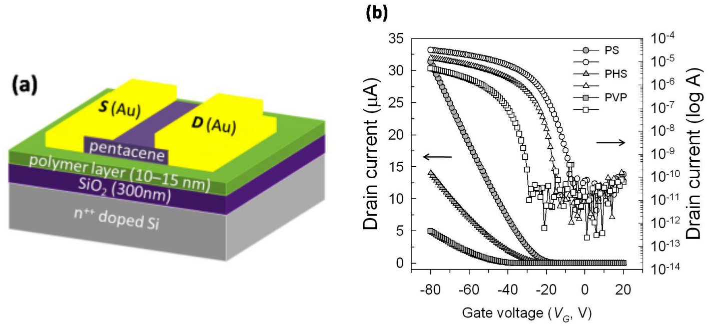
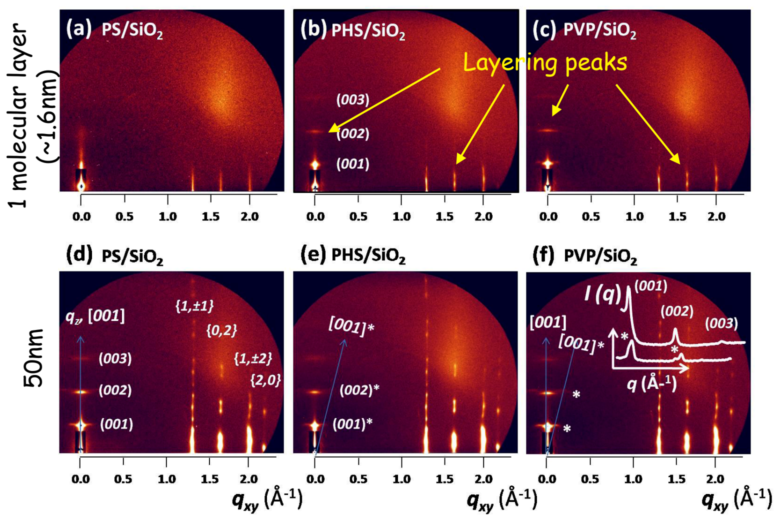
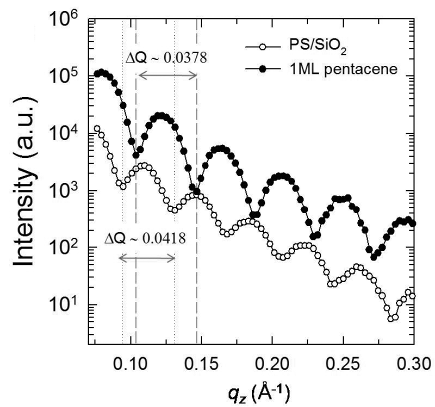
Structures in organic semiconductors

Motivation: Surface energy affects the structure of organic semiconducting materials self-assembled on a substrate. By manipulating the surface energy by using polymer-coated substrates, the structure of the material (pentacne) can be controlled to improve the performance of the device.



Key result 1: Grazing incident X-ray diffraction (GID) results show that when the amount of deposited materials is equivalent to 1 single molecular layer, the structure on PS-coated substrate is likely 1 single layer (see result 2), whereas islands formed (layering) on the other two substrates (confirmed by AFM). As more materials were deposited, a single crystal structure persist on the PS-coated substrate, while a second structure with distinct layer spacing ("bulk phase" rather than "thin film phase) and layer orientation appeared on the other two substrates. These data suggest that the structures on PS-coated substrate contain fewer domain boundaries, explaining why the device fabricated on the PS-coated substrate performed the best (highest carrier mobility).





Key result 2: X-ray reflectivity (XR) data collected using the same area detector used for GID measurements show that the thickness of the single molecular layer (by deposited weight) pentacene film is indeed consistent with the molecule size of 1.6nm.

Conclusion and significance: This study is a demonstration of the use of X-ray scattering methods (GID and XR) to elucidate structure-performance relationship for organic semiconducting materials. Both types of measurement were accomplished using the same instrumentation at X21.

Pentacene nanostructures on surface-hydrophobicity-controlled Polymer/SiO2 bilayer gate-dielectrics

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