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Defects and Deformation in Organic Molecular Semiconductors[1]

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We have been investigating microstructural defects in crystalline organic molecular semiconductors such as pentacene and soluble pentacene derivatives. We have examined the structure of grain boundaries, dislocations, and vacancies in these materials by polarized optical microscopy, X-ray diffraction, transmission electron microscopy, electron diffraction, low voltage electron microscopy, and low dose high resolution electron microscopy. We have quantified the nature and extent of local relaxations that occur near these structural defects. We have also studied the micromechanisms of plasticity using nanoindentation and scratching. Our microstructural studies provide detailed information about the defect-mediated mechanisms of plastic flow. We have also examined pentacene derivatives that can be processed from solution, and have found information about solid-state phase transformations that result in internal cracking within the organic semiconductor crystals. We have also examined the relationship between the type and density of these defects and the macroscopic properties in devices such as thin-film transistors.

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