Kent State University
Physics Colloquium

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Order Out of Chaos: Microscopic Studies on Layered Conjugated Polymer Nanowhiskers

Abstract

Polymer materials have been utilized as building blocks of many functional structures due to their unique mechanic properties originated their capabilities to twine and entangle their polymer chains. However, in optoelectronic applications, this disorderliness is not always favored. By carefully tailor-designing its molecular structures, some conjugated polymers exhibit extraordinary intendancy to form crystalline structures with superior optoelectronic properties. Poly(3-hexylthiphene) (P3HT) is capable of self-assembling into ordered 1D nanostructures with enhanced properties compared to its amorphous film. Herein, atomic force microscopy (AFM) and its advanced modes are used to study the local morphology and electronic property of monolayer and double-layer nanowhisker, the most fundamental forms of the P3HT nanowhiskers. The polymer chain packing integrity of the monolayer nanowhiskers is probably compromised by structural fluctuations induced by its local environments, evidenced by our AFM measurements. The local contact potential difference values of overlapped, deformed, and triple-stacked nanowhiskers are substantially higher than that of straight section of nanowhiskers. The findings here provide insights on the effects of molecular packing and local adsorption environments on electronic properties of conjugated polymer aggregates that are difficult to resolve in bulk thin films.

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