DEPARTMENT OF
CHEMISTRY
UNIVERSITY OF NEBRASKA-LINCOLN

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Professor
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3:15 Reception
3:30 Seminar
112 Hamilton Hall

"Crystal Design for Organic Semiconductors"

The electronic and photophysical properties of organic materials depend critically on the precise arrangement of chromophores in the solid state. In the most highly ordered cases - organic single crystals - we find that shifts in solid state order of only a few tenths of an Å can render a high-performance semiconductor useless, and that minuscule changes in substitution pattern can dramatically enhance performance. Using a simple functionalization scheme, we have developed a reproducible method for altering and tuning the solid-state order of a wide array of linearly-fused aromatic and heteroaromatic semiconductors. The scheme can induce an array of π-stacked arrangements, and the impact of solid-state order on performance in several different device applications will be explored. In general, transistors with high charge carrier mobility benefit from the closest intermolecular contacts and dense crystal packing, although for good film formation they must also adopt a lamellar secondary structure in the crystal. In contrast, materials for photovoltaics perform best in simple 1-D or linear π-stacked arrangements. And to exploit many photophysical phenomena, the materials must show little to no π-stacking in the solid state. This talk will cover the various crystalline motifs that can be adopted by small-molecule semiconductors, their film-forming and device performances, and the impact of isomeric purity on crystallization and charge-transport in thiophene-fused aromatic systems.

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