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Tunable Molecular Orientation and Elevated Thermal Stability of Vapor-Deposited Organic Semiconductors DIANE WALTERS, SHAKEEL DALAL, University of Wisconsin-Madison, IVAN LYUBIMOV, JUAN DE PABLO, University of Chicago, MARK EDIGER, University of Wisconsin-Madison — Physical vapor deposition is commonly used to prepare organic glasses that serve as active layers in organic electronic devices. Orienting the molecules in such layers can significantly enhance device performance. We apply a high-throughput characterization scheme to investigate the effect of the substrate temperature ($T_{Substrate}$) on glasses of three organic molecules utilized as semiconductors. Using spectroscopic ellipsometry, we find that molecular orientation in these glasses is continuously tunable and controlled by $T_{Substrate}/T_g$, where T_g is the glass transition temperature. All three molecules can produce highly anisotropic glasses; the dependence of molecular orientation upon substrate temperature is remarkably similar and nearly independent of molecular length. All three compounds form "stable glasses" with high density and thermal stability similar to stable glasses of model glass formers. Simulations reproduce the experimental trends and explain molecular orientation in the deposited glasses in terms of the surface properties of the equilibrium liquid. By showing that organic semiconductors form highly orientated stable glasses, these results provide an avenue for systematic performance optimization of active layers in organic electronics.

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