Effects of Non-Covalent Interactions on Polymers Containing Polar Backbone Rings

Allison R. Wong, Jorge Barroso, Luc G. Wetherbee, Bess Vlaisavljevich, Jessica R. Lamb

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Non-covalent interactions can strongly influence the structure and properties of polymers, with hydrogen bonds as a prevalent example for the formation of higher-ordered structures and improvement of mechanical properties. Dipole-dipole interactions, which can have similar strengths to hydrogen bonds, also enhance polymer performance compared to nonpolar analogues. Among dipole-containing polymers, differences in the strength, location, density, and orientation of the dipoles can further tune properties. However, the effects of varying these characteristics for strong, oriented dipoles incorporated into the polymer main chain are unknown. Herein, we systematically investigate the impacts of dipole strength and orientation in polymers containing polar backbone rings. We designed a model system of three ring-opening metathesis-based polymers: two polyoxazolidinones (POxa) with comparable dipole strengths but different orientations and one polyoxazolidine (POxi) with a considerably weaker dipole. Beyond the different dipole characteristics, each polymer also displayed different coordination behavior to the ruthenium catalyst during the polymerization. These variations in non-covalent interactions (i.e., dipole-dipole, metal-ligand) greatly impacted the polymerization reactivity as well as the thermal and rheological properties of the corresponding materials. The resulting structure-property relationships advance fundamental understanding of polymers with polar backbone rings and help inform the design of this promising class of materials.