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Influence of Reversibly Associating Side Group Bond Strength on Viscoelastic Properties of Polymer Melts[1] CHRISTOPHER LEWIS, KATHLEEN STEWART, MITCHELL ANTHAMATTEN, University of Rochester —
Reversible hydrogen-bonding between side-groups of linear polymers can sharply influence a material's dynamic mechanical behavior, giving rise to valuable shape memory and self-healing properties. Here, we investigate how bond-strength affects the bulk rheological behavior of functional poly(n-butyl acrylate) (PBA) melts. A series of random copolymers containing three different reversibly bonding groups (aminopyridine, carboxylic acid, and ureidopyrimidinone) were synthesized to systematically vary the side-group hydrogen bond strength (∼26, 40, 70 kJ/mol). The materials' volumetric hydrogen-bond energy densities can be tuned by adjusting the side-group composition. By comparing the viscoelastic behavior of materials containing an equivalent bond energy density, with different bonding groups, the efficacy and cooperativity of reversible binding can be directly examined. Melt rheology results are interpreted using a state-of-ease model that assumes continuous mechanical equilibrium between applied stress and resistive stresses of entropic origin arising from a network of reversible bonds.

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