Tuning the Physicochemical Properties of Polysaccharides via Cross-linking Conditions

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Abstract

Polyurethanes (PUs) were prepared by cross-linking β-cyclodextrin (β-CD) with two different types of diisocyanates, respectively. Materials with diverse structural and textural properties were obtained by varying the rate of diisocyanate addition: rapid (R) or drop-wise (D; 0.1 mL/min). Characterization of the structural and textural properties was investigated by spectroscopic (1H NMR in solution, solid state 13C CP-MAS solids NMR, dynamic light scattering, UV-vis, and IR), thermogravimetric analysis, powder x-ray diffraction, and scanning electron microscopy. The accessibility of the β-CD inclusion sites of the polymers was independently evaluated using an equilibrium dye adsorption method at equilibrium and in parallel with a kinetic dye-based uptake method. The characterization methods strong support that drop-wise additions affords materials with greater cross-linking relative to the rapid addition method. Herein, we report the first example of a cross-linked polyurethane containing β-CD with tunable structure and physicochemical properties, according to the mode of cross-linker addition (R versus D) to control the reaction conditions.