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Tertiary phase diagram of cellulose, ionic liquid and organic solvent XIN ZHANG, DOUG HENDERSON, Department of Materials Science and Engineering, University of Maryland, MADHUSUDAN TYAGI, YIMIN MAO, NCNR, NIST, Gaithersburg, MD, ROBERT M. BRIBER, HOWARD WANG, Department of Materials Science and Engineering, University of Maryland — Cellulose is the most abundant natural polymer on earth, and widely used in products from clothing to paper. Fundamental understanding of molecular solutions of cellulose is the key to realize advanced technologies beyond cellulose fibers. It has been reported that certain ionic liquid/organic solvent mixtures dissolve cellulose. In this study, the tertiary phase diagram of microcrystalline cellulose, 1-Ethyl-3-methylimidazolium acetate (EMIMAc), and dimethylformamide (DMF) mixtures has been determined using optical cloud point method and small angle neutron scattering (SANS). Data indicate that a molar ratio of EMIMAc to cellulose repeating unit equal or greater than 3 is necessary but not sufficient in forming one-phase homogeneous solutions. A miscibility gap exists in the dilute regime, where a minimum of 5 mol% of EMIM Ac in DMF is needed to form homogenous solutions. SANS show that cellulose chains adopt Gaussian-like conformation in homogenous solutions. The solutions exhibit the characteristics of upper critical solution temperature. Clustering of cellulose chains occurs at low EMIMAc/DMF or EMIMAc/cellulose ratio, or at low temperatures. The mechanism of cellulose dissolution in tertiary mixture is discussed.

Xin Zhang
Department of Materials Science and Engineering, University of Maryland

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