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Small-angle Neutron Scattering Study on Cellulose Nanocrystal Solution: Phase Behavior and Magnetic Alignment YIMIN MAO, Department of Materials Science and Engineering, University of Maryland, College Park/NCNR, NIST, XIN ZHANG, DOUG HENDERSON, HOWARD WANG, ROBERT BRIBER, Department of Materials Science and Engineering, University of Maryland, College Park, UMD/NCNR TEAM — Cellulose nanocrystals (CNC) were prepared using a sulfuric acid hydrolysis method. CNC dispersions were characterized using small-angle neutron scattering (SANS) technique at both single particle and concentrated suspension levels. The former revealed a parallelepiped particle shape with a length of ∼150 nm, and the cross-sectional dimensions of ∼3×20 nm. The CNC dispersion showed lyotropic liquid crystal behavior which could be qualitatively described by Onsager's model for rod-like particle solution. Between CNC concentrations (mass fraction) of ∼6% to ∼8%, the homogenous solution spontaneously phase separated into a dense phase having birefringence, and an optically isotropic phase. The birefringent phase showed chiral nematic characteristics under polarized microscope, with chiral pitch distance on the micron scale; with interparticle distances of ∼40 nm, as revealed by SANS. The CNC stacking can be quantitatively examined using a 1D para-crystal model. Under weak magnetic field (0.4 T), the chiral nematic stack in the birefringent phase can be re-oriented with the pitch direction aligned with the magnetic field. The isotropic phase cannot be aligned under weak magnetic field.

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