Phase Behavior, Rheology, and Solidified Microstructure of Aqueous Cholesterogenic Nanomesogen Systems

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Controlling the final microstructure and properties of solid materials (e.g. coatings, films, fibers) assembled from lyotropic nanomesogens requires understanding their phase behavior, quiescent microstructure, rheological behavior and the microstructural changes that occur during solvent evaporation. This research compares the properties of cholesterogenic aqueous dispersions of sulfonated cellulose nanocrystals (CNC)[1,2] and single walled carbon nanotubes (SWNT) stabilized by double-stranded DNA (dsDNA).[3,4] These two systems differ signficantly in terms of the relative importance of electrostatic and van der Waals forces, mesogen aspect ratio, and mesogen rigidities. A key distinction between the two systems is that the high ionic strength of the CNC system results in the viscosity versus concentration curve not exhibiting a minimum at the biphasic to liquid crystal transition. In contrast, the dsDNA/SWNT system does exhibit this minimum which is typically associated with the biphasic to liquid crystal transition for macromolecular lyotropic dispersion. This rheological behavior directly affects the processing of the dispersions into films.

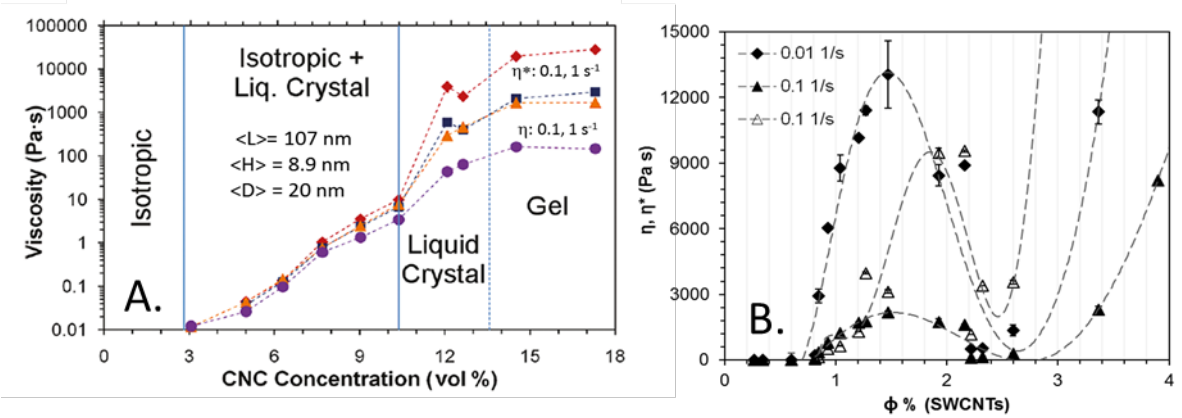

Figure 1. Viscosity versus concenetration for A.) aqueous sulfonated CNC and B.) dsDNA/SWNT. Closed symbols indicate steady shear, open symbols indicate oscillatory shear. [1,4]

References

[1] Ureña-Benavides, E. E.; Ao, G.; Davis, V. A.; Kitchens, C. L. *Macromolecules* **2011**, *44*, 8990.
[2] Haywood, A. D.; Davis, V. A. *Cellulose* **2017**, *24*, 705.
[3] Ao, G.; Nepal, D.; Aono, M.; Davis, V. A. *ACS Nano* **2011**, *5*, 1450.
[4] Ao, G.; Nepal, D.; Davis, V. A. *Rheol. Acta* **2016**, *55*, 717.