Cellulose Dissolved in Aqueous Tetrabutyl Ammonium Hydroxide

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Cellulose is the World's most abundant biopolymer and an important renewable raw material source for many different materials. The spinning of textile fibers or casting of films are typically done from solutions. However, cellulose is fascinatingly insoluble in most common solvents, and finding clean and useful solvents for cellulose, still remains a challenge. One promising solvent that has been proposed is, 40 wt.% aqueous tetrabutyl ammonium hydroxide, TBAH(aq). In this solvent we have characterized the dissolution state of microcrystalline cellulose (MCC, M_w≈29 kD), and dissolving pulp (M_w≈162.3 kD), using a combination of ^{1}H NMR diffusion, rheology, light and small angle X-ray scattering (SAXS). At lower concentrations (< 0.05 g/cm^3 for MCC and < 0.02 g/cm^3 for pulp) cellulose is molecularly dissolved while at higher concentrations aggregation and gelation is observed, resulting in strongly shear thinning samples. The cellulose is preferentially solvated by TBA$^+$ ions, as seen by SAXS and NMR diffusion experiments. From TBA$^+$ diffusion we estimate a constant "binding" of 1.2 TBA$^+$ ions per glucose monomer unit. From these results we will also briefly discuss some of the particular requirements of good cellulose solvents.

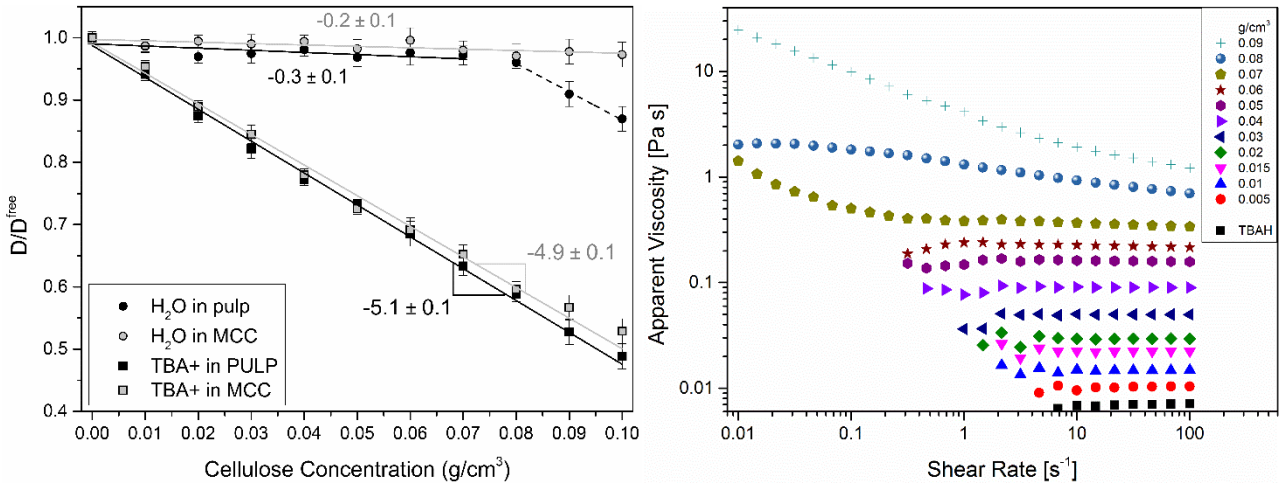

Figure 1 (Left) Relative diffusion coefficients of H_2O-OH and TBA$^+$ as a function of cellulose (MCC and pulp, respectively) concentration. **(Right)** Viscosity profiles in the range of shear rate between 0.01 and 100 s^{-1} from 0.005 to 0.09 g/cm^3 of MCC in 40 wt% TBAH(aq).

Acknowledgements The work was supported by the Bo Rydin Foundation for Scientific Research and the Swedish Research Council.

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