Amphiphilic properties of cellulose and their role in dissolution, regeneration and nanocomposite preparation.

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Cellulose is a polymer so widely abundant and versatile that we can find it almost everywhere in many different forms and applications. Cellulose dissolution is a key aspect of many processes. Cellulose is known to be insoluble in water and in many organic solvents, but can be dissolved in a number of solvents of intermediate properties, like N-methylmorpholine N-oxide (NMMO) and ionic liquids (ILs) which, apparently, are not clearly related. Cellulose can also be dissolved in water at extreme pHs, in particular if a cosolute of intermediate polarity is added. We review the main achievements in the dissolution area and discuss underlying mechanisms. Recent work has much emphasized the role of cellulose charge and the concomitant ion entropy effects, as well as hydrophobic interactions, rather than strong intermolecular hydrogen bonding between cellulose molecules as was suggested in much earlier work. Thus we argue that cellulose is significantly amphiphilic. In addition to presenting recent work on novel cellulose solvents we illustrate the association and precipitation of cellulose from rheology studies, and how they can be affected by other amphiphilic compounds. Cellulose has a strong tendency to re-assemble when dissolved; this process is strongly affected by surfactants and other additives affecting hydrophobic interactions. Cellulose dissolution and regeneration have had important applications for a long time, mainly for textile fibers and for the preparation of cellulose derivatives. In this work we have considered the co-regeneration of cellulose with another polysaccharide. Thus novel cellulose-chitosan nanocomposite particles with spherical shape were successfully prepared via mixing of aqueous biopolymer solutions. Using different protocols, particles of different sizes, biopolymer distribution and porosity could be prepared.