Novel Hydrophobically Associative Cellulose Nanofibers for Controlled Suspension Rheology of Nanoscale Fluids

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In recent years, cellulose materials have gained significant attentions because of their excellent structural stability as well as unique rheological fluidity [1,2]. This study synthesizes hydrophobically associative cellulose nanofibers (ACNFs) by using combined surface-mediated living radical polymerization and 2,2,6,6-tetramethylpiperidine-1-oxyl radical(TEMPO)-mediated oxidation. More specifically, cellulose nanocrystals were grafted with poly (stearyl methacrylate-co-2-methacryloxyethyl phosphorylcholine) hydrophobic and zwitterionic polymer brushes. Finally, the TEMPO-mediated oxidation enables production of nanoscale cellulose nanofibers. We have found that the cellulose nanofibers can not only dramatically increases the viscosity of aqueous solution due to the hydrophobic attraction, but also display excellent tolerance to pH changes and salt addition due to formation of structurally fiber gel network. The results obtained in this study highlight that that the incorporation of hydrophobically associative polymer brushes onto the surface of ACNFs is indeed important and play a role in fabrication of high performance nanoscale fluids.

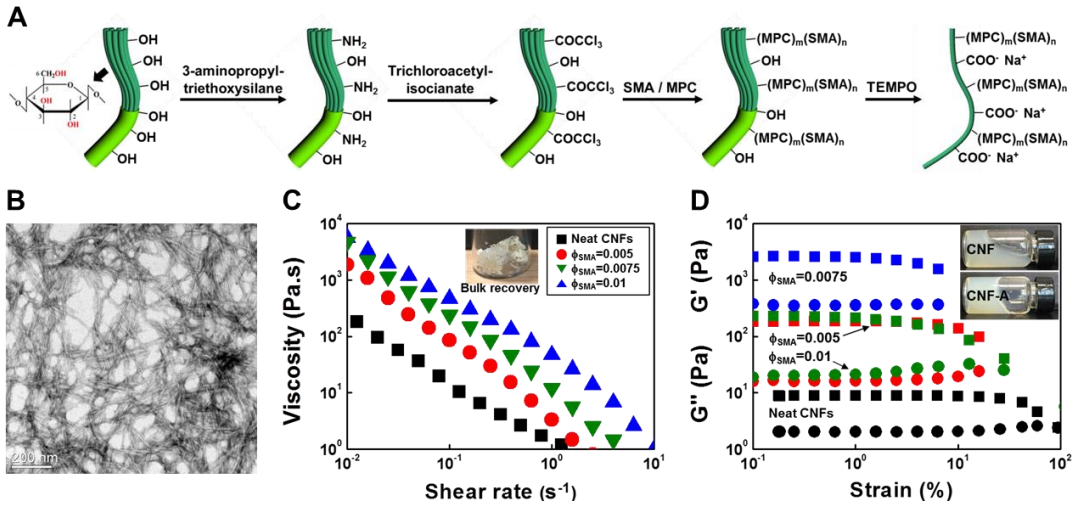

Figure 1. (A) Schematic illustration for grafting poly (SMA-co-MPC) brushes on CNFs by using surface-mediated living radical polymerization. (B) TEM images of poly (SMA-co-MPC) grafted ACNFs. ϕ_{SMA} = 0.0075. (C) Viscosity behaviors of CNF suspensions as a function of shear rate. The effect of the weight fraction of SMA in the polymer (SMA-co-MPC) brushes. (D) Storage modulus, G‘ and loss modulus, G'' changes as a function of oscillation strain.

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References

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