Materials Day 2024 Abstract

Alignment of functionalized cellulose nanocrystals using electric field and mechanical shear

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Abstract:

This research focuses on the alignment of Anionic Hairy Cellulose Nanocrystals (AHCNCs), which are surface-modified forms of cellulose nanocrystals (CNCs), with a net charge of 5.24 mmol/g at both ends. The negative charges at both ends increase the number of dipoles within the CNCs, potentially enhancing their non-centrosymmetric piezoelectric properties. However, the strong repulsive forces between the charged ends of the CNCs make their alignment challenging and require specific strategies.

Previous studies have examined the dipole alignment of CNC films, revealing that changing their orientation is not easily achievable. However, dispersing the cellulose materials in a suitable solvent and applying magnetic or electric fields, or shear stress, offers a better potential for alignment. Our prior work revealed that magnetic field partially aligns the CNCs. In the present work, we investigate use of other external fields such as shear rate, AC, and DC fields to study their effect on AHCNCs alignment.

Preliminary results show that, in the case of AHCNCs exposed to DC electric fields, ectrophoresis dominates, where the AHCNCs migrate toward one of the electrodes; whereas AC electric fields show the greatest potential for aligning both CNCs and AHCNCs, where the frequencies dominate the CNC alignment and the amplitude of the electric field affects the dipole orientation.