A nanocellulose-based polymer brush systems templating ability for metal nanoparticles

Lauren Geurds, Jan Lauko, Alan E. Rowan, Nasim Amiralian
Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Brisbane, Queensland, Australia.
LG: l.geurds@uq.edu.au, JL: l.lauko@uq.edu.au, AER: alan.rowan@uq.edu.au, NA: n.amiralian@uq.edu.au

Cellulose nanocrystals (CNC) are sustainable, and biodegradable materials with numerous chemically accessible hydroxyl functional groups, allowing straightforward surface modifications. Grafting polymers through surface-initiated Atom Transfer Radical Polymerisation (SI-ATRP) from CNC has proved to be an efficient technique for introducing desired functionality such as stimuli responsiveness and controlling their dispersibility in different solvents and polymers [1-3]. A commonly described initial step to enable the grafting of polymers on nanocrystals is through the esterification of cellulose with 2-Bromoisobutyryl bromide (BiBB), creating cellulose nano initiators [4]. However, there is no consistent model of the BiBB treatment in literature, including the impact of the surface modification on the morphology.

Here we demonstrate an optimised approach for the surface modification of CNC, controlling the degree of substitution of the BiBB initiator grafted on the nanocrystal surface while maintaining the rod-like morphology, cellulose I crystalline structure, and the degree of crystallinity. These surface-modified nanocrystals enable the grafting of polymer brush systems with controllable lengths, densities, and functionalities. Understanding how reaction parameters control and impact the characteristic properties of CNC and degree of substitution will guide the future tailoring of the surface modification and, as a result, facilitate the growth of inorganic nanorods on the CNC-polymer brush template for advanced applications.

Figure 1, CNC-based polymer brush systems as a versatile platform for metal synthesis.

References
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