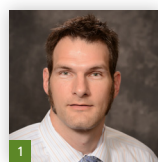


Editorial: green nanocomposites

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Welcome to the themed issue of *Green Materials*, focused on 'green nanocomposites'. We decided on this theme because nanocomposites offer extraordinary opportunities to tailor mechanical, chemical, barrier and electrical properties, while simultaneously using components adapted to a sustainable society. While their potential applications in the energy, healthcare, environment, defense, electronics and aerospace sectors are garnering significant interest, the environmental and health impacts of nanomaterials are primary concerns.¹ Carbon nanotubes not only offer tremendous opportunities, but also have one of the highest production energies of any material.² As a result, there is a growing demand for 'green' or 'sustainable' nanomaterials that have much lower environmental impact, which provided the motivation for this themed issue of *Green Materials*.

At the outset, we envisioned a variety of types of nanocomposites – nanoclay, nanocellulose, nanochitin and so on – but, after receiving an overwhelming amount of manuscripts, a strong secondary theme emerged – cellulose nanocomposites. Each of the papers in this issue utilizes cellulose in some fashion, either as a matrix or as reinforcement. Cellulose is the primary structural unit for plant life, and as such there is more cellulose available than any other organic polymer.³ During biosynthesis, cellulose arranges into a microfibrillar structure with highly crystalline regions.⁴ An extraction of the fibrillar structures by mechanical or chemo-mechanical means provides cellulose nanofibrils (CNFs) that are microns long and 5–15 nm in square cross-section depending on the source of the cellulose. An extraction of the crystalline domains by chemical hydrolysis of the less-ordered regions of the cellulose provides cellulose nanocrystals (CNCs) that are ~3–10 nm in cross-section and 50–500 nm long. As cellulose is simply the food-labeled 'fiber', it is non-toxic, causes no auto-immune reactions when used in vivo and, because cellulose originates from biosynthesis using atmospheric carbon dioxide, it can indeed be regarded as sustainable.

This themed issue on green nanocomposites presents seven articles that highlight the advances in cellulosic nanocomposites. The first paper, a short communication by Larsson *et al.*,⁵ presents a detailed morphology study on the effect of cross-linking on CNF films. Such films are of high interest for barrier applications, and cross-linking stabilizes them against moisture. In the next paper, Mueller *et al.*⁶ show that it is possible to prepare CNC/poly(vinyl alcohol) nanocomposite aerogels that are stable against water simply by heating, which is much 'greener' than the common method of using tetraborate. Uddin *et al.*⁷ present a detailed study on the role of carboxyls in the use of CNCs as a dispersant and nucleation site for the synthesis of silver nanoparticles. As the methods for carboxylation are well known, this provides a nice tool to tailor and optimize the system. The following paper by Peng *et al.*⁸ details the improvements in the mechanical properties of CNC/epoxy nanocomposites by predispersing the CNCs in hardener – essentially using the hardener as an in situ dispersant. Abitbol *et al.*⁹ compare CNCs with fumed silica in latex coatings. For cellulosic nanomaterials to truly become relevant, comparisons with commercially used fillers in composites are necessary. Teipel and Grunlan² show that there is a synergy between CNCs and other fillers (Boehmite) in epoxy nanocomposites. Such interactions between materials are important to elucidate in real systems. In the last paper, Cavallaro *et al.*¹⁰ report the preparation of halloysite nanotube nanocomposites with cellulose and chitosan. As halloysite is a natural clay, its availability along with cellulose and chitosan is plentiful and sustainable.

When taken together, these seven papers represent a nice snapshot of the current state of the art in cellulosic nanocomposites. We hope you enjoy reading them as much as we have!

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