

ABSTRACTS (MASTER THESIS)

Cellulose nanofiber-reinforced composites using acrylic resin latex

(Graduate School of Agriculture,
Laboratory of Active Bio-based Materials, RISH, Kyoto University)

Hiroki Yatsui

Introduction

Cellulose nanofibers (CNFs) exhibit high strength and low thermal expansion and have been investigated and used as reinforcing components in composite materials. However, the hydrophilic nature of CNFs makes it difficult to mix them uniformly in hydrophobic resins. As a result, CNFs are frequently chemically modified to improve their affinity to resins. However, chemical modification of CNFs is very costly, which limits the extent of their application. The objective of this research was to reinforce hydrophobic resin with CNFs using latex that consisted of nanosized acrylic resin droplets.

Experiment

A TEMPO-oxidized CNF-water suspension and acrylic resin latex with nanosized droplets (~200 nm) were mixed using a blender. The mixture was filtered and the residue was dried to prepare CNF composite sheets. The mechanical properties and dynamic viscoelastic properties of the samples were studied.

Results and discussion

Nanospheres were found to keep their original shape in the transparent CNF-acrylic resin composites (Figure 1). The addition of CNF increased the Young's modulus and strength of the resin (Figure 2). The Young's modulus of the resin increased 380-fold with only 5% addition of CNF. The tensile strength of the resin also increased with increasing CNF content and it was nearly 9-fold higher for the nanocomposite with 5% CNF. The composites showed high electrical conductivity when they were mixed with silver nanowires. The electrical conductivities of the composites were found to change with stretching.

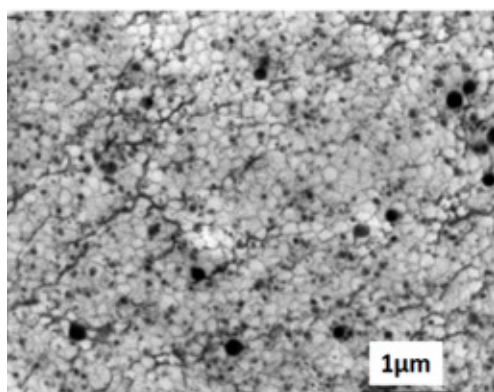


Figure 1. CNF-acrylic resin composite.
(CNF: 2.5%, scale bar: 1 μm)

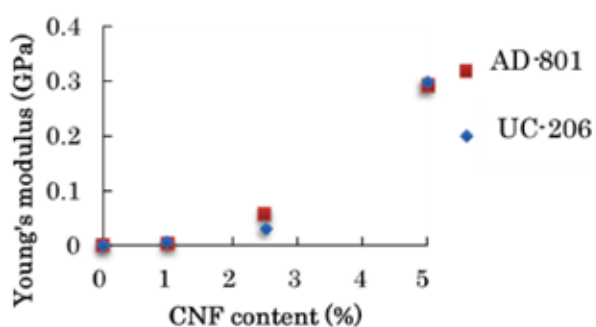


Figure 2. Young's modulus of composites