ABSTRACTS (MASTER THESIS)

Reinforcement of polypropylene with surface modified cellulose nanofiber

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Introduction

In order to reinforce polypropylene (PP) with cellulose nanofiber (CNF), it is effective to introduce hydrophobic functional groups on the surface of CNF. In this work, we chose eight types of functional groups (Figure 1). Each functional group was introduced on the surface of CNF by esterification. Chemically modified CNF/PP composites were prepared, and mechanical properties of these composites were evaluated.

Experimental

Preparation of surface modified CNF: Bacterial cellulose (Fujicco Co., Ltd.) was disintegrated by blender. After wash and solvent exchange, functional group was introduced on the surface of CNF by esterification(Fig. 1). The progress of reaction was determined by elemental analysis and FT-IR. The dispersibilities of the CNF samples in cyclohexane was tested.

Preparation of CNF/PP composite: Chemically modified CNF /PP (Japan Polypropylene Co.) composites (fiber content:5 wt %) were prepared by hot press(170℃). Mechanical properties of these composites were evaluated by tensile tests.

Results and discussion

Preparation of surface modified CNF: The FT-IR spectra of the CNF samples showed the typical signals of the ether groups. The degree of substitution was 0.15. CNF sample 1,2,4,8 in cyclohexane (solubility parameter δ 8.21, PP: δ 8.31) showed good dispersibilities of CNF.

Mechanical properties of CNF/PP composite: The results of tensile tests showed Table 1. The modulus of Film 1 is higher than Film 2, whereas dispersibilities of CNF in both composites was similar. This is because that blanched chain improved the interaction between filler and matrix. The modulus of Film 4 is almost same as that of Film 2. The modulus of Film 7 is lower than those of Film 2,4, because naphthalene is so incompatible with PP that the dispersibility of CNF was low. In order to get good dispersibilities of CNF, PP-like chain is necessary (Film 8). Therefore, the mechanical properties of the composite were efficiently enhanced by PP-like functional groups, which allowed good dispersibilities of CNF in the PP matrix and strong interactions between CNF and PP matrix.

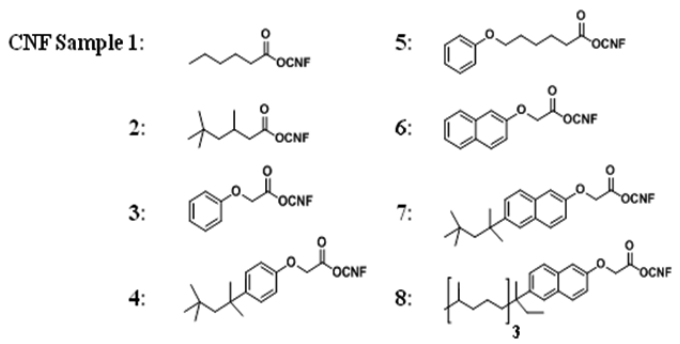

Figure 1. Eight surface modified CNFs

Table 1. The results of tensile tests

Film	Modulus [GPa]
Film 1 : CNF Sample 1/PP	2.42
2 : 2/PP	3.14
3 : 3/PP	2.91
4 : 4/PP	3.17
5 : 5/PP	2.19
6 : 6/PP	2.40
7 : 7/PP	2.82
8 : 8/PP	3.13
9 : PP	2.08