Synthesis and Evaluation of Cellulose Gel Materials Using Polymerizable Ionic Liquids

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Cellulose hydrogels are attractive materials for medical applications due to their hydrophilicity and biocompatibility. These characteristics make them promising for use as wound dressings. However, cellulose is typically insoluble in water and common solvents due to strong hydrogen bond networks, but can be dissolved in ionic liquids (ILs). This study aims to develop 3D materials with high strength based on cellulose by using ILs. In our previous study, we fabricated cellulose gels without any additives.[1] To enhance strength, the composite gel materials based on cellulose and IL polymers will be prepared.

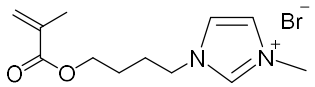

Fig 1. Chemical structure of IL monomer.

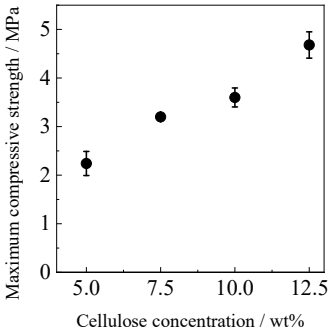

Fig 2. Relationship between maximum compressive strength and cellulose concentration for cellulose hydrogels.

Cellulose solutions composed of Avicel®, 1-butyl-3-methylimidazolium chloride ([C4mim]Cl), IL monomer (Figure 1), and photo initiator were prepared. The amounts of [C4mim]Cl and the IL monomer were fixed at 3.00 g and 0.100 g, respectively, while the cellulose concentration was varied from 5 to 12.5 wt% relative to [C4mim]Cl. The IL monomer in the cellulose solutions was polymerized by UV irradiation (365 nm, 20 min). The cellulose hydrogels were obtained by washing with distilled water for 24 h to remove [C4mim]Cl.

To investigate the surface morphology of cellulose hydrogels, various hydrogels with varying cellulose concentrations were freeze-dried and observed by using Scanning Electron Microscopy (SEM). Regardless of the cellulose concentration, a dense structure was observed for the cellulose hydrogels, while a porous structure was observed for cellulose hydrogels that were composed of cellulose only. These results suggest that pore in hydrogels was filled with the IL polymer. Figure 2 shows the maximum compression strength of hydrogels with various cellulose concentrations. The maximum compressive strength increased with increasing cellulose concentration and was 4.68 MPa for the hydrogels with 12.5 wt% cellulose. This enhancement should be based on the increase in the entanglement of cellulose chains and IL polymers.

References

1. Arata M.; Putri, D. A.; Thomas, M. L.; Takeoka, Y.; Rikukawa, M.; Yoshizawa-Fujita, M. * *ChemSusChem*, **2025**, 18, e202401848.

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