
 ABSTRACTS (MASTER THESIS)

Artificial lignification using wood cell wall models

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One of factors of making trees enable to support their big body against the gravity is deposition of lignin into gaps of cellulose and hemicellulose in wood cell wall (lignification). This mechanism is thought that wood cell wall forms fiber-reinforced composite structure by lignification. However, this process and mechanical properties changes caused by lignification are still unclear.

In this study, wood cell wall models were prepared using cellulose nanofiber hydrogel. Cellulose nanofiber is the main components of cell walls and plays main structures of them. Cellulose microfibrils were isolated from wood powder (Japanese cypress, 60 mesh) by Wise method and alkaline treatments. Isolated cellulose microfibrils were fibrillated by a grinder to nanofibers. Cellulose nanofiber forms hydrogels by alkaline treatment. In detail, NaOH was dissolved in suspension of cellulose nanofiber and got 8 wt% concentration of NaOH. Next, cellulose nanofiber was treated by centrifugation (11,000 rpm, 30 minutes). The precipitate was neutralized, and got hydrogel of cellulose nanofiber. One of lignin models is DHP (Dehydrogenation Polymer). DHPs made from coniferyl alcohol were used in this study. Coniferyl alcohol, peroxidase, and H₂O₂ were dissolved in solvent composed ethanol: water=3:1, and cellulose nanofiber hydrogel were immersed into them. After 24 hours, ethanol was vaporized under vacuum pressure. Then DHPs synthesized in hydrogels. Those gels were rinsed by distilled water and repeated DHP synthesis.

Those processes made it possible to reproduce lignification in vitro. Those hydrogels looked like actual wood cell wall in the SEM observation (Fig.1), and compression strength was increased as increasing the time of DHP synthesis. It is thought that gaps of cellulose nanofiber networks are fulfilled by lignin (DHPs) and reinforced. It is also thought that there is some interactions between lignin and cellulose nanofiber because DHPs don't form spherical shapes, and those two components fixed rigidly.

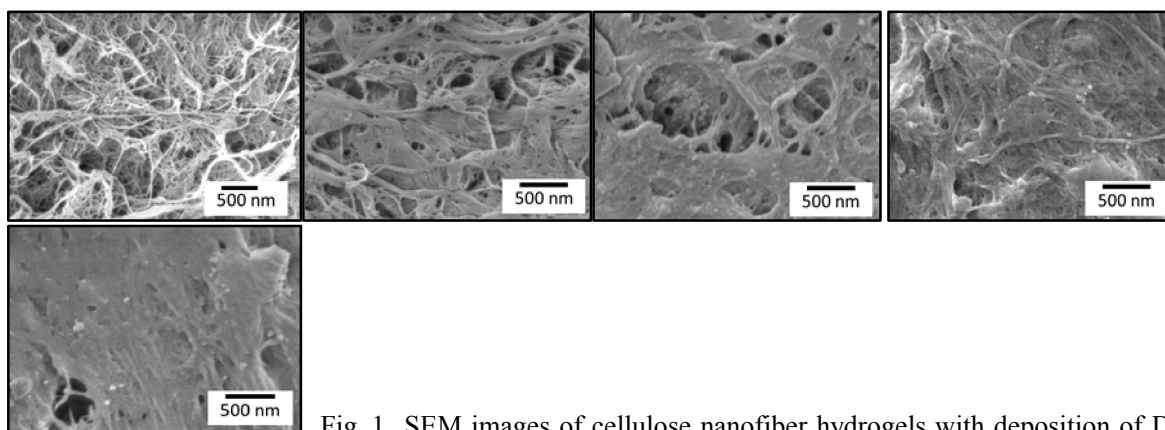


Fig. 1. SEM images of cellulose nanofiber hydrogels with deposition of DHPs (From upper left, the time of DHP synthesis is 0,1,2,3,4)