Development of Highly Oriented CNF Long Filaments by Air Drying

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Cellulose nanofibers (CNF) are attracting attention as a sustainable natural resource for reducing environmental burden. CNF is a lightweight, high-strength renewable resource, and further increases in strength are expected by enhancing the orientation of the fibers.

In previous studies, it was confirmed that producing CNF in a filamentary form result in high orientation and improved mechanical properties[1]. There is a need for longer CNF filaments that offer high performance at a lower cost. In this study, we aim to develop a simple, low-cost method for producing filaments composed solely of CNF, with the goal of achieving high orientation and long lengths through air drying.

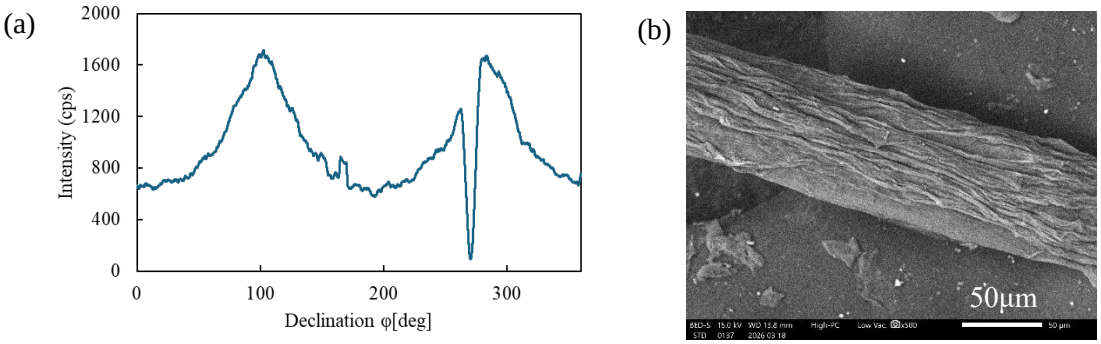

Figure 1. (a) the relationship between the X-ray diffraction angle and intensity (b) SEM image

Test specimens were produced by filling a syringe with Sugino Machine Co., Ltd.'s 2 wt% CNF water dispersion (Ima-10002), manually extruding the material, and air-drying. A 1 ml syringe was used, fitted with a 38 mm long needle having an inner diameter of 0.25 mm and a flat-tipped design. It was possible to produce a filament up to approximately 150 mm in length with a diameter of 100 μm or less.

Fig. 1(a) shows the relationship between the diffraction angle and intensity in X-ray diffraction. It confirms the fiber of orientation. Fig. 1(b) shows a SEM image of the produced CNF filament. It clearly demonstrates the high orientation of the CNF.

In addition, tensile strength is evaluated. Further improvements in performance are being considered.

[1] Guantong Wang et al, "Enhanced High Thermal Conductivity Cellulose Filaments via Hydrodynamic Focusing", NANO Letters, Vol. 22. No.21, pp. 8406-8412, 2022.