Effect of viscosity on fabricated hollow silica fiber by electrospinning

Shun NOGUCHI*, Sathish K. SUKUMARAN*, Takashi TANIGUCHI**,
Masataka SUGIMOTO*, Kiyohito KOYAMA*
*Graduate School of Science and Engineering, University of Yamagata
4-3-16 Jonan, Yonezawa, Yamagata 992-8510, Japan
**Department of Chemical Engineering, Kyoto University, Kyoto 615-8510, Japan
noguchi@ckpss.yz.yamagata-u.ac.jp

[Introduction]

Hollow nanofibers with walls made of ceramics have been prepared by electrospinning two immiscible liquids through a coaxial, two-capillary spinneret, followed by selective removal of the cores. In previous study, the effect of feeding rate on formation of hollow fiber was investigated. However, the effect of viscosity of the precursors was not considered.

Therefore, the purpose of this study is to investigate the effect of viscosity on formation of hollow fiber.

[Experiment]

Samples were tetraethoxysilane(TEOS),ethanol, water, and hydrochloric acid (as a catalyst). Samples were heated at 80°C in 30% RH and made a sol-gel precursor. Co-electrospinning was carried out at room temperature, 30%RH, 20kV, 10cm nozzle-collector distance, and 0.0012ml/min (inner) – 0.012ml/min (outer) flow rate.

[Results and discussion]

Fig.1 shows viscosity of each reaction time. The viscosity of precursors increased with reaction time. The low viscosity precursor (0.01 Pas) gave vise to droplets in electrospinning. With increasing viscosity of precursor (0.02~0.7 Pas), fibers were obtained as nonwoven mats. After remove the oil core by immersing the fibers in octane for 24 hours, we confirmed that these fibers were hollow fibers.

However, from the precursor with viscosity 0.7Pa s, a crack was observed on fiber surfaces. We consider that it results from the difference of viscosity between outer precursor and inner oil core. The big difference of viscosity causes unevenness of wall thickness of hollow silica fibers like core-sheath fibers by melt spinning. Thus hollow fibers are easy to crack.

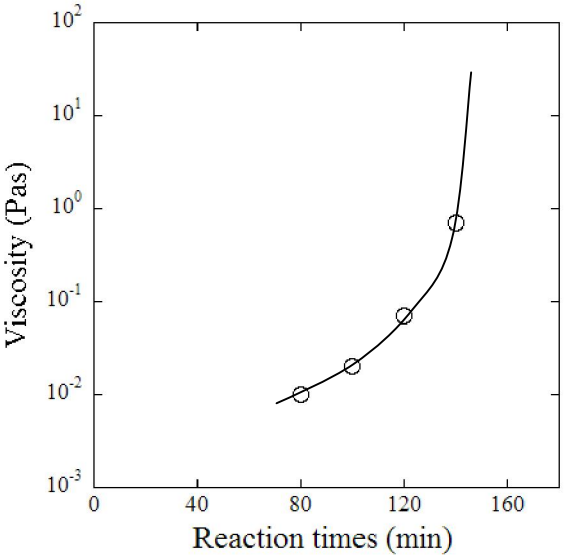

Fig.1 Variation of viscosity of silica precursor with polymerization time. Polymerization temp is 80 °C and measurement temp is 25 °C