BUBBFIL SPINNING FOR MASS-PRODUCTION OF NANOFIBERS

by

Rou-Xi CHEN, Ya LI, and Ji-Huan HE*

Nantong Textile Institute, Soochow University, Nantong, China
National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, Suzhou, China

Short paper
DOI: 10.2298/TSCI1405718C

Bubbfil spinning is a generalized bubble electrospinning, including bubble spinning, blown-bubble spinning, and membrane spinning, for mass production of nanofiber. This paper shows small bubbles in liquid membrane are the best candidate for uniform nanofibers.

Key words: *bubble-electrospinning, nanofiber, nanobubble*

Introduction

Bubble electrospinning [1] is a promising technology for mass production of nanofiber, and it has been developing very fast into bubbfil spinning, which use bubbles from polymer solutions or melts or films (membranes) for fabricating nanofibers using either electronic force or blowing air or both, sometime mechanical force (*e. g*. centrifugal force) or magnetic force is also used. This paper focuses on micro or nano bubbles for producing uniform nanofibers.

Experiment

A 7 wt.% polyvinyl alcohol (PVA) solution is used in our experiment, the applied voltage is 15 kV and the distance between the solution surface and the metal receiver is 30 cm. All the experiments were carried on at temperature 20 degrees with a relative humidity of 53%. The spinning process was performed on the bubbfil spinning equipment (Nantong Bubbfil Nanotechnology company limited). In the spinning process thin film is produce to form uniform micro or nano bubbles. The size of produced bubbles mainly depends upon the thickness of the produced film. The spinning process is illustrated in fig.1, where we can see millions of jets, which are solidified to nanofibers after solvent evaporation, fig. 2, which shows the morphology of the obtained uniform nanofibres observed by field emission-scanning electronic microscopy (S-4800, Hitachi Ltd., Japan).

Figure 1. The spinning process of small bubbles in liquid membrane

* Corresponding author; e-mail: hejihuan@suda.edu.cn

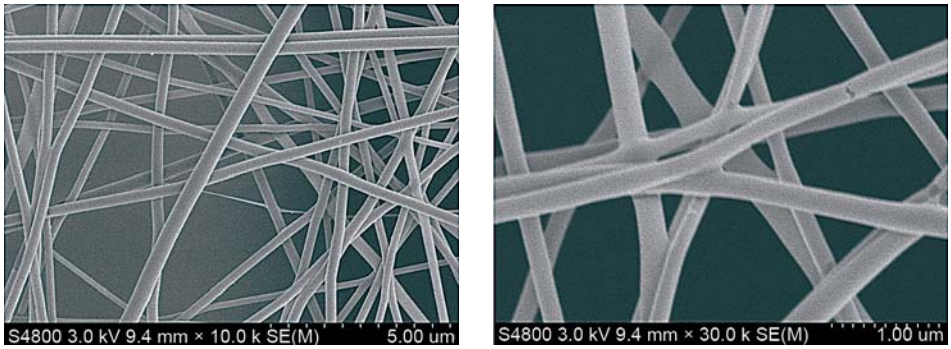

Figure 2. The SEM images of PVA fibers

Discussions and conclusions

In the spinning process, a thin and a uniform film is produced, which can produce millions of microbubbles or nanobubbles simultaneously. Due to the very short lifetime for small bubbles (the lifetime for a nanobubble with diameter of 10 nm is about 10^{-6} s) [2], that means it is impossible for bubbles for interaction with each other to form a bigger ones before they are ejected under the electrostatic force, that means millions of micro or nano bubble are ejected simultaneously to mass-produce uniform nanofibers.

Acknowledgments

The work is supported by Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD), National Natural Science Foundation of China under grant No. 11372205 and Project for Six Kinds of Top Talents in Jiangsu Province under grant No. ZBZZ-035, Science & Technology Pillar Program of Jiangsu Province under grant No. BE2013072, Natural Science Foundation of the Jiangsu Higher Education Institutions of China under grant No. 14KJA130001 and Natural Science Foundation of the Jiangsu Higher Education Institutions of China under grant No. 14KJA130001.

References

[1] He, J.-H., *et al*., Review on Fiber Morphology Obtained by Bubble Electrospinning and Blown Bubble Spinning, *Thermal Science*, *16* (2012), 5, pp. 1263-1279
[2] Craig, V. S. J., Very Small Bubbles at Surfaces the Nanobubble Puzzle, *Soft Matter, 7* (2011), 1, pp. 40-48

Paper submitted: March 30, 2014
Paper revised: May 3, 2014
Paper accepted: July 12, 2014