

MICRO-NANOFIBERS WITH HIERARCHICAL STRUCTURE BY BUBBFIL-SPINNING

by

Peng LIU^{a,b}, Juan-Juan CAI^c, Lei ZHAO^{d,e}, and Ji-Huan HE^{a,b*}

^a Nantong Textile Institute, Soochow University, Nantong, China

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

^c Nantong Bubbfil Nanotechnology Company Limited, Nantong, China

^d College of Textile and Costume, Yancheng Institute of Industry Technology, Yancheng, China

^e Jiangsu R&D Center of the Ecological Textile Engineering and Technology, Yancheng Institute of
Industry Technology, Yancheng, China

Short paper

DOI: 10.2298/TSCI1504455L

Bubbfil spinning is used to fabricate micro/nanofibers with hierarchical structure. The wall of a polymer film is attenuated unevenly by a blowing air. The burst of the bubble results in film fragments with different thickness, as a result, different sizes of fibers are obtained.

Key words: *micro-nanofibers, bubble electrospinning, polyethersulfone, hierarchical fibers, hierarchical filtration*

Introduction

Bubble electrospinning [1-3] has been developing into a matured bubbfil spinning, which becomes a promising technique for mass-production of micro/nanofibers [4-7]. The fiber diameter mainly depends upon the wall thickness of a polymer bubble. In this paper we develop a technology to produce bubbles with uneven thickness. The bubbfil spinning experimental set-up is given in fig. 1, where a blowing air is used to thin the wall of bubble.

Experiment

A 25 gram polyethersulfone (PES) was dissolved in the dimethylacetamide at ambient temperature for 24 hours to achieve an PES solution with concentration of 25 w/w.%. The applied DC voltage is 30 kV, the distance between the solution surface and the metal collector is 22 cm. The morphology of bubbfil-spun PES fibers is investigated by scanning electron microscopy (SEM).

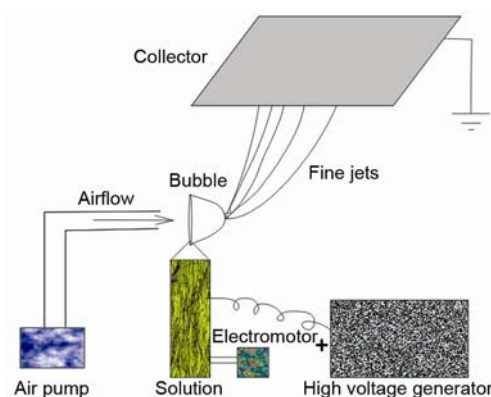


Figure 1. Bubbfil spinning from Nantong Bubbfil Nanotechnology Company Limited

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

An air flow directs to the center of the polymer film as illustrated in fig. 1. This results in the change of the film to a hemisphere, and its wall thickness becomes thinner, while the center sees the thinnest wall. When it is broken, various fragments are produced, the fragment with a thinner wall will be drawn to a thinner fiber, as a result, fibers with hierarchical structure are observed as illustrated in fig. 2.

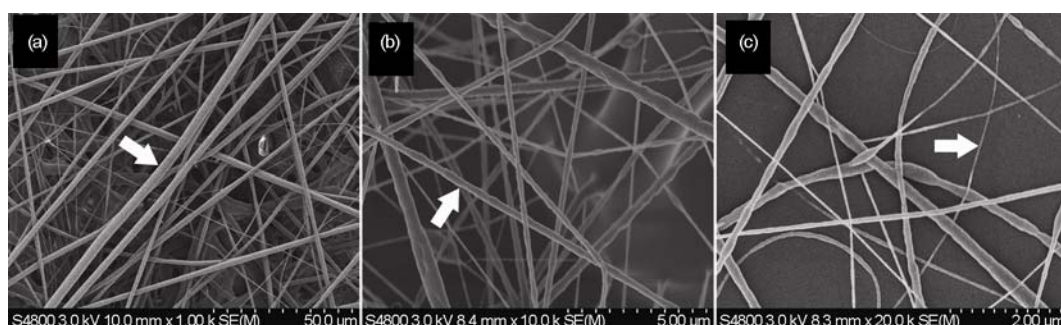


Figure 2. The SEM images of bubbfil-spun PES fibers with hierarchical structure

Conclusion

The paper elucidates the mechanism of fabricating different sizes of fibers in bubbfil spinning process, and the blowing air plays an important role. The hierarchical fibers are extremely useful for hierarchical filtration.

Acknowledgment

The work is supported by Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD), National Natural Science Foundation of China under grant No. 61303236 and 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.

References

- [1] Kong, H. Y., He, J.-H., A Modified Bubble Electrospinning for Fabrication of Nanofibers, *Journal of Nano Research*, 23 (2013), July, pp. 125-128
- [2] He, J.-H., et al., Bubble Electrospinning for Fabrication of Yarns with Hierarchical Structure, *Bubbfil Nanotechnology*, 1 (2014),1, pp. 33-36
- [3] 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
- [4] Chen, R. X., et al., Mini-Review on Bubbfil Spinning Process for Mass-Production of Nanofibers, *Materia*, 19 (2014), 4, pp. 325-343
- [5] Chen, R. X., et al., Bubbfil Spinning for Mass-Production of Nanofibers, *Thermal Science*, 19 (2014), 5, pp. 1718-1719
- [6] Li, Z. B., He, J.-H., When Nanotechnology Meets Filtration: From Nanofiber Fabrication to Biomimetic Design, *Materia*, 19 (2014), 4, pp. 1-3
- [7] Li, Y., Comparison between Electrospun and Bubbfil-Spun Polyether Sulfone Fibers, *Materia*, 19 (2014), 4, pp. 363-369

Paper submitted: February 10, 2015

Paper revised: April 12, 2015

Paper accepted: April 21, 2015