NANO-DYEING

by

Cui-Juan NING [a], Chun-Hui HE [b], Lan XU [a], Fu-Juan LIU [a], and Ji-Huan HE [a*]

[a] National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, Suzhou, China
[b] Nantong Bubbfil Nanotechnology Company Ltd., Nantong, China

Short paper
DOI: 10.2298/TSCI1603003N

Dyeing nanofibers is a frontier of both modern textile engineering and nanotechnology. This paper suggest a feasible method for dyeing nanofibers with a natural red (Roselle Calyx) by bubble electrospinning. Reactive dye (Red S3B) and acid dye (Red 2B) were also used in the experiment for comparison. The dyeing process was finished during the spinning process.

Key words: *bubbfil spinning, polyvinyl alcohol, natural dye, synthetic dye*

Introduction

Natural dyes [1-3] from plants have been used since ancient times for coloring various fabrics, however, it was rarely reported that natural dyes can be used to dye nanofibers. In this paper, a natural red extracted from *roselle calyx* was used to color nanofibers during the bubble electrospinning process [4, 5].

Experimental

Roselle calyx, a raw material of natural red, was obtained from the campus of Soochow University. The 3 g *roselle calyx* was soaked in 30 g deionized water for 10 hours. Then it was boiled in 80 °C water for 1 hour. The obtained solution was filtered by the filter paper. Polyvinyl alcohol (PVA) solution was prepared with 8 wt.% by using the filtered solution at room temperature, and it was magnetically stirred at 90 °C until a homogeneous and transparent solution was obtained. Then the final solution was cooled down at room temperature. Sodium dodecyl benzene sulfonate was added to the PVA solution and magnetically stirred at normal atmospheric temperature. For comparison, PVA solutions with dye additives of reactive dye (Red S3B) and acid dye (Red 2B), respectively, were also prepared by the same method.

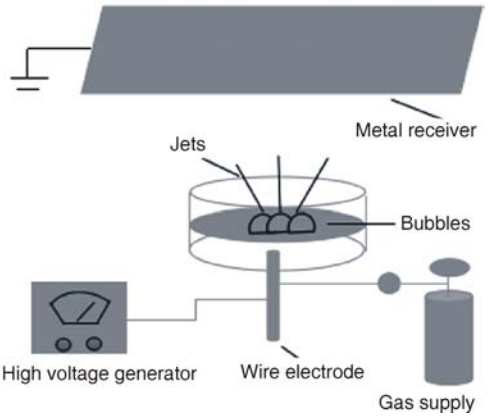

Figure 1. Bubbfil spinning experiment set-up

The bubbfil spinning experiment set-up was provided by Nantong Bubbfil Nanotechnology Company Limited, and illustrated in fig. 1. The experiment was carried out at

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

room temperature. The applied voltage and the bubble-to-collector distance were 30 kV and 20 cm, respectively.

Results and conclusions

Figure 2 gave the photos of colored PVA nanofiber membranes using dyes of natural red (A), Red S3B (B), and Red 2B (C), respectively. The morphology of the bubble electrospun nanofibers were observed by a scanning electron microscopy (SEM), fig. 3. The diameter distribution was shown in fig. 4. It could be seen that natural red resulted in much smaller nanofibers than Red S3B and Red 2B.

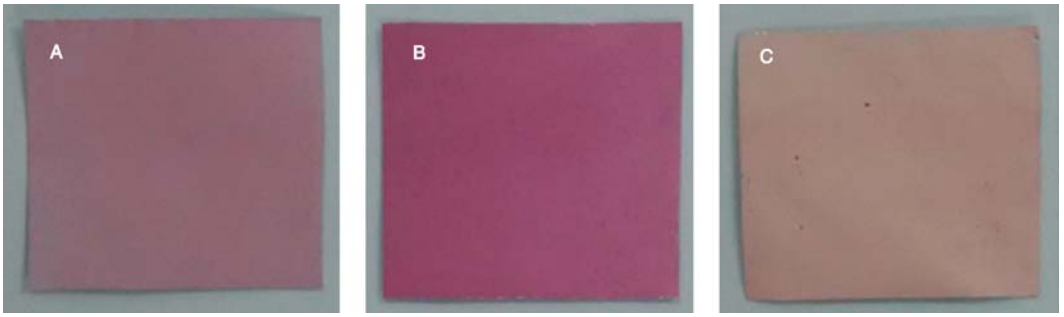

Figure 2. The photos of colored PVA nanofiber membranes with dye additives of natural red, Red S3B, and Red 2B, respectively *(for color image see journal web site)*

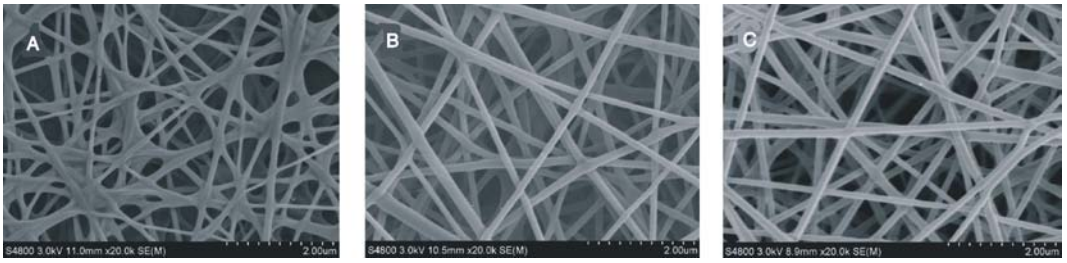

Figure 3. The SEM images of nanofibers with dye additives of natural red, Red S3B, and Red 2B, respectively

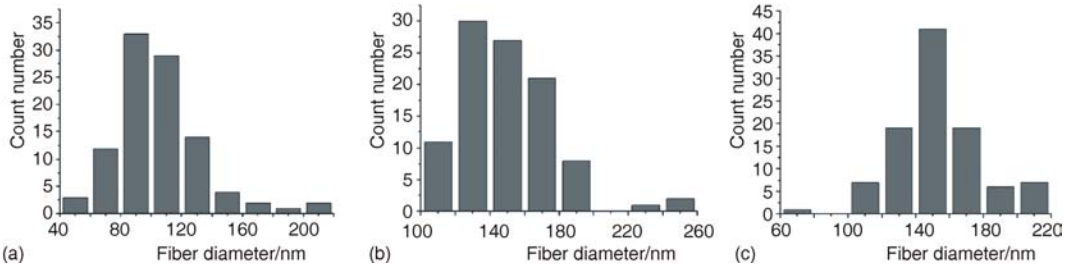

Figure 4. Diameter distribution of nanofibers with dye additives of natural red, Red S3B, and Red 2B, respectively

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. 61303236, 51403143, and 11372205, Natural Science Foundation of the Jiangsu Higher Education Institutions of China (Grant No. 14KJA130001), Natural Science Foundation of Jiangsu Province under Grant No. BK20140398, Project for Six Kinds of Top Talents in Jiangsu Province under grant No. ZBZZ-035, and Science and Technology Pillar Program of Jiangsu Province under grant No. BE2013072.

References

[1] Rajni, S., *et al*., Antimicrobial Activity of some Natural Dyes, *Dyes and Pigments, 66* (2005), 2, pp. 99-102
[2] Cristea, D., *et al*., Improving Light Fastness of Natural Dyes on Cotton Yarn, *Dyes and Pigments, 70* (2006), 3, pp. 238-245
[3] Grifoni, D., *et al.*, The Role of Natural Dyes in the UV Protection of Fabrics Made of Vegetable Fibres, *Dyes and Pigments, 91* (2011), 3, pp. 279-285
[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*., Bubble Rupture in Bubble Electrospinning, *Thermal Science, 19* (2015), 4, pp. 1141-1149

Paper submitted: May 10, 2015
Paper revised: November 5, 2015
Paper accepted: December 12, 2015