Preface

Frontiers of Nanofiber Fabrication: from electrospinning, vibration electrospinning to bubble electrospinning

Hong-Yan Liu[1], Ji-Huan He[2]

1. School of fashion technology, Zhongyuan University of Technology, Zhengzhou 450007, China
Email: phdliuhongyan@gmail.com

2. National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, 199 Ren-Ai Road, Suzhou 215123, China
Email: hejihuan@suda.edu.cn

Nanofiber fabrication is of indispensable importance for the scientific and economical revival of the developing world. As pointed out by M.S. El Naschie that the nanoage is something of a Hemingway line of demarcation between the have and the have nots [1].

There are many advanced technologies [2-6] so far for fabrication of various nanofibers, the most used one is electrospinning. Fig.1 shows the rocketing development of electrospinning since early 2000s by Thomson Reuters' web of science.

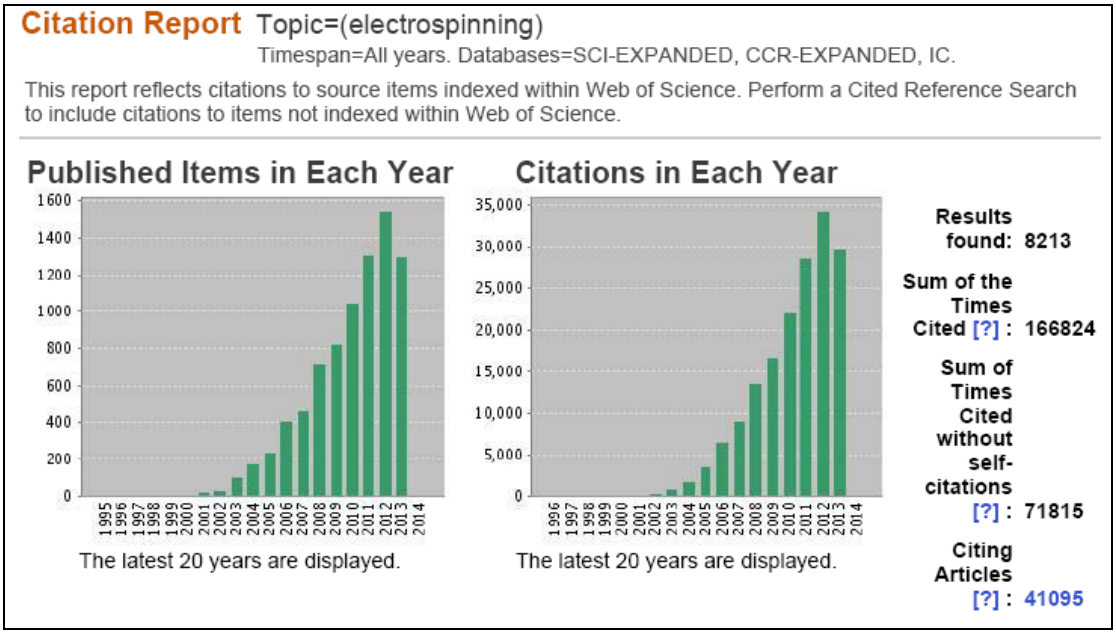

Fig.1 Publications on electrospinning according to Web of Science (October 28, 2013)

However, this technology has an intrinsic demerit for mass-production of nanofibers as discussed by Wan et al. [7] in this issue. To overcome this bottleneck, several new but effective technologies arise. The vibration-electrospinning can greatly enlarge spinnability, which is especially suitable for solutions with extreme viscosity, which will block the needle easily in conventional electrospinning. The ultrasonic vibration can greatly reduce the viscosity of the solution, making the impossible possible, see articles by Wan et al. [7] and Si et al. [8]. The bubble electrospinning is another promising candidate for mass-production of nanofiber. Contrasted to traditional electrospinning, where the electronic force is used to overcome surface tension of the Taylor cone, the bubble

electrospinning is to use the electronic force to overcome the surface tension of a bubble, which reads

$$\sigma = \frac{1}{4} r \Delta p$$

where σ is the surface tension, r the radius of the bubble, and Δp the pressure difference. The most interest property is that the surface tension of a polymer bubble does not depend upon the solution properties, so the spinnability is generally independent of its solution properties. When the electronic force overcomes the surface tension of a polymer bubble, multiple jets eject for fabrication of nanofibers, see papers by Sun et al. [9] and Kong & He [10] in this issue.

In this issue, a modification of the bubble electrospinning is suggested by Dou et al. [11]. Instead of electronic force used in bubble electrospinning, blowing air is used as an acting force to overcome the surface tension of a bubble, the technology is termed as blown bubble spinning, which is especially effective for fabrication of micro-yarns composed of nanofibers.

This special issue covers mainly electrospinning, vibration-electrospinning, bubble electrospinning and blown bubble spinning, and it is a good reference not only for materials science, but also for various communities in physics, nanotechnology and chemistry.

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 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] M.S. EI Naschie, Nanotechnology for the developing world, Chaos Soliton Fract. 30 (2006) 769–73.

[2] J.H. He, Y.Q. Wan, L. Xu, Nano-effects, quantum-like properties in electrospun nanofibers, Chaos Soliton Fract. 33 (2007) 26-37.

[3] J.H. He, Effect of temperature on surface tension of a bubble and hierarchical ruptured bubbles for nanofiber fabrication, Therm. Sci., 16 (2012),325-328.

[4] J.-H. He, H.-Y. Kong, R.-R. Yang, et al., Review on fiber morphology obtained by the bubble electrospinning and Blown bubble spinning, Therm. Sci., 16 (2012) 1263-1279.

[5] H.Y. Kong, J.H. He, A Modified Bubble Electrospinning for Fabrication of Nanofibers, Journal of Nano Research, 23(2013) 125-128.

[6] J.H.He,The Smaller, the Better: From the Spider-Spinning to Bubble-Electrospinning, Acta Physica Polonica A, 121(1)(2012) 254-256.

[7] N. Si, L. Xu, M.-Z. Wang, F. Liu, Effect of Ultrasonic Vibration on Electrospun Poly (vinyl alcohol) (PVA) Nanofibers.

[8] Y.-Q. Wan, J. Qiang , L.-N. Yang, et al., Vibration and Heat Effects on Electrospinning Modeling.

[9] X. F. Sun, Y. Liu, L.-K. Wen, et al., Multi-bubble Electrospinning of Nanofibers.

[10] H. Dou, H.-Y. Liu, J.H. He, Fabrication of Micro Yarn Composed of Nanofibers by Blown Bubble Spinning.