COPPER/PA66 NANOFIBERS BY BUBBFIL-SPINNING

by

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Copper/PA66 nanofibers are fabricated by the bubbfil spinning, and their thermal stability is studied by calcination treatment. It reveals that the addition of copper nanoparticles can greatly improve the thermal stability of nanofibers.

Key words: *PA66/Cu nano-fiber membranes, bubble-electrospinning, particle size distribution, calcination treatment*

Introduction

Zero-dimensional nanoparticles have larger specific surface area, better thermal and electrical properties compared with its massive aggregate. Recently much attention had been paid to fabricating metal particle disperse in polymer matrix by chemical reaction [1, 2]. Hou and Reneker [3] used carbon nanotubes as additives to prepare for carbon nanofibers by electrospinning. Copper nanofibers were used for high performance Li-ion batteries [3] and were also used in small devices by connecting with or encapsulating in some precision components to realize the function of electromagnetic shielding. Not only can Cu nanoparticles go through the surface of polymer, but also they can deposit into the surface of polymer nanofibers. However, the output of Cu nanofibers was extremely low and could not meet the requirement of industrial applications. To overcome the shortcoming, this paper finds that the bubbfil spinning [4-8] is a facile method for mass-production of Cu nanofibers.

Experimental

Nylon-6/66 solution was prepared, and copper sulfate was added into the solution as additive in the bubbfil spinning [4-8]. Figure 1(a) shows typical field emission scanning electron microscope (FE-SEM) micrograph of the obtained nanofibers, and fig. 1(b) revealed unsmooth surface where copper nanoparticles might be distributed on the surface. The additive of Cu nanoparticles will greatly affect thermal stability of PA66 nanofibers. Different sizes of Cu nanoparticles are added to the solution to study the after-burning property.

Figure 2 shows that the morphologies of Cu nanofibers for different sizes of nanoparticles after burning. It is obvious that smaller particles result in larger pores as shown in fig. 2(a), when the size of particles increases, the fibers begins to aggregate together as shown in fig. 2(b), and when particle size further increases as shown in fig. 2(c), Cu particles begin to be aggregated on fibers' surface.

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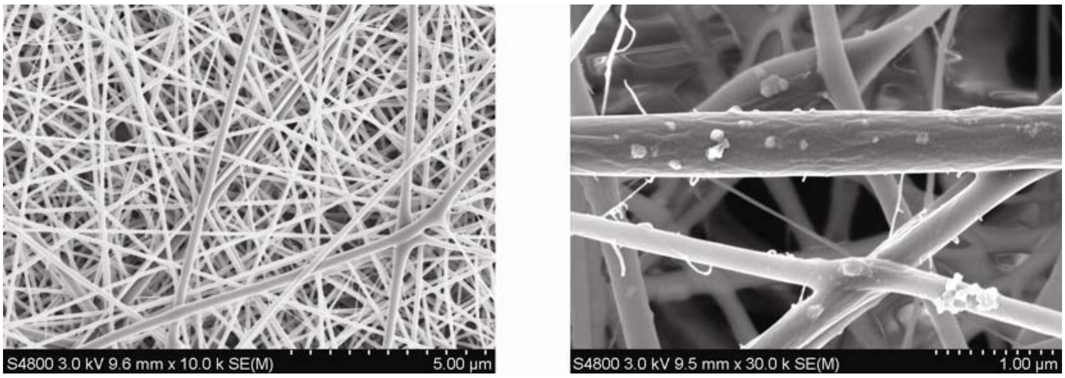

Figure 1. The FE-SEM micrograph of fibers from nylon6/66 dissolved in the formic acid

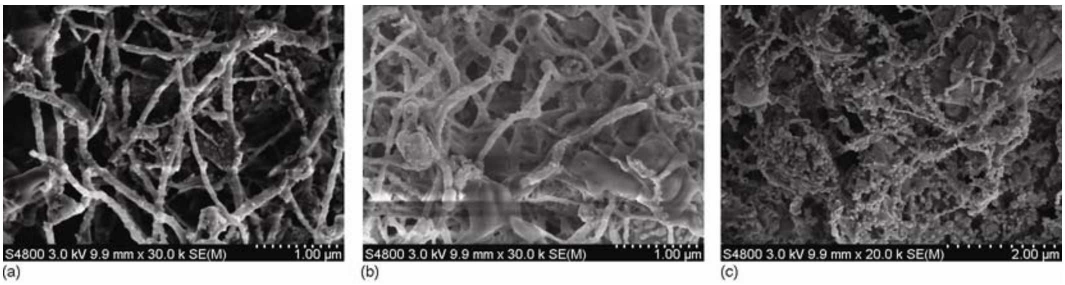

Figure 2. The morphology of Cu nanofibers after polymer burned; (a) 10~100 nm, (b) 100~500 nm, (c) 500~1000 nm

Conclusion

The paper concludes that addition of metal nanoparticles on the spun solution will great affect the morphology of the obtained fibers, and their thermal stability increases greatly. Cu nanofibers have potential applications for heat-resisting materials.

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References

[1] Chen, P., *et al.*, The Preparation of Polymer-Metal Nanocomposites and the Application, *Polymer Bulletin, 74* (2006), 2, pp. 18-23
[2] Nam, S. H., *et al.*, Copper Nanofiber-Networked Cobalt Oxide Composites for high Performance Li-ion Batteries [J], *Nanoscale Research Letters, 6* (2011), 1, pp. 1-7
[3] Hou, H., Reneker, D. H., Carbon Nanotubes on Carbon Nanofibers: a Novel Structure Based on Electrospun Polymer Nanofibers, *Advanced Materials, 16* (2004), 1, pp. 69-73
[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] 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
[7] Li, Z. B., He, J.-H., When Nanotechnology Meets Filteration: From Nanofiber Fabrication to Biomimetic Design, *Materia, 19* (2014), 4, pp. 1-3
[8] Li, Y., Comparison between Electrospun and Bubbfil-Spun Polyether Sulfone Fibers, *Materia, 19* (2014), 4, pp. 363-369

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