전기방사를 이용한 금나노 입자가 함유된 폴리비닐알콜 나노섬유의 제조

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Preparation of High Molecular Weight Atactic Poly(vinyl alcohol) Nanofiber Containing Gold Nanoparticles by Electrospinning

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1. Introduction

Polymer/inorganic nanoparticle composites have been the focus of extensive research efforts through the past decade. The introduction of inorganic nanoparticles into the polymer matrix has proved to be an effective and low-cost method to improve the performance of the existing polymer materials. When nanometer-sized particles are applied, these benefits can be achieved at very low loading levels as a result of their unusually large specific surface area. Poly(vinyl alcohol) (PVA) ultrafine fibers containing gold nanoparticles were successfully prepared by electrospinning. A simple method of the organic-inorganic composite ultrafine fibers, which consist of high molecular weight (HMW) atactic-PVA and gold nanoparticles, was made through directly mixing water-based colloidal gold and HMW a-PVA solution in the absence of any tedious post processing such as the precipitation-redissolution and photoreduction employed by others investigation, or any external reducing agents.

2. Experimental

2.1. Materials

To synthesize HMW a-PVA having a number-average degree of polymerization of 4000, Vinyl acetate (VAc) was suspension-polymerized in water at 40℃ with ADMVN as an initiator, and subsequent saponification. Water-based nano colloidal gold was supplied from MIJI-TECH Co., Ltd., Korea.

2.2. Preparation of PVA/gold composite ultrafine fibers

HMW a-PVA was dissolved in water at 90 ℃ for 4h to ensure homogenization. Concentration of HMW a-PVA aqueous solutions were varied to 3.5, 4.5 and 5.5 wt%. In order to prepare the PVA/gold composite ultrafine fibers, various concentration of HMW a-PVA aqueous solution with small amounts of gold colloidal solution (0.25, 0.50 and 0.75 wt% to amount of PVA) were used. To prepare homogeneous polymer solution containing gold nanoparticles, gold colloidal solution was mixed to the HMW a-PVA solution at 60 ℃ for 2h. Applied voltage was fixed 25, and 30 kV. In addition, tip to collector distance was varied to 6, 9, and 12 cm.

2.3 Characterization

The morphologies of HMW a-PVA/gold composite ultrafine fibers were analyzed by the scanning electron microscopy (SEM) (Hitachi, S-4100, Tokyo, Japan) after gold coating.

3. Results and Discussion

SEM images of HMW a-PVA fibers electrospun from HMW a-PVA (3.5, 4.5, and 5.5 wt%) solutions are shown in Figure 1, 2. With increasing the concentration of HMW a-PVA, the thickness of fiber was getting more and more fine and the number of beads of ultrafine fibers were decreased.

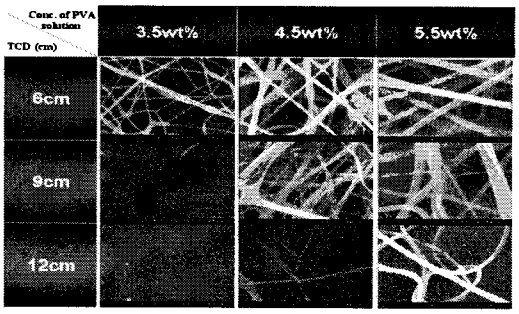

Figure 1. SEM images of HMW a-PVA fibers electrospun from 25kV

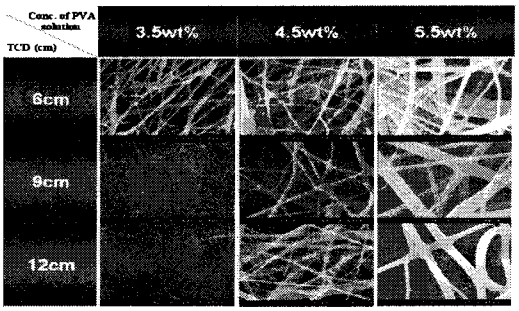

Figure 2. SEM images of HMW a-PVA fibers electrospun from 30kV

SEM images of HMW a-PVA/gold composite ultrafine fibers electrospun from HMW a-PVA (4.5wt%) with gold colloidal solution (0.25 and 0.5 wt% of PVA) are shown in Figure 3, 4. The morphologies of ultrafine fibers grew finer at 30 kV than that of 25 kV in applied voltage. However the difference with amount of gold particles was unconfirmed. This will be confirmed by transmission electron microscopy (TEM) in future.

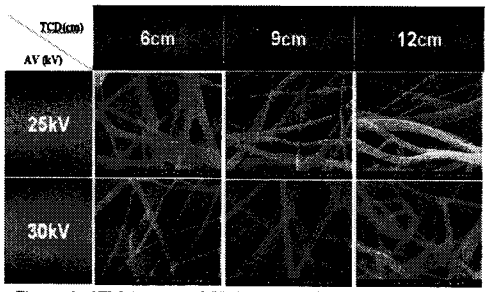

Figure 3. SEM images of HMW a-PVA/gold composite fibers electrospun from 4.5wt% of HMW a-PVA solution with small amount of gold colloidal solution (0.25 wt% of the aount of HMW a-PVA).

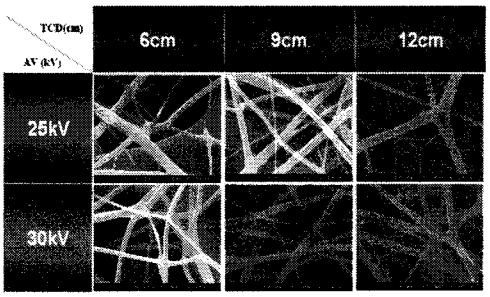

Figure 4. SEM images of HMW a-PVA/gold composite fibers electrospun from 4.5wt% of HMW a-PVA solution with small amount of gold colloidal solution (0.50 wt% of the aount of HMW a-PVA).

4. Acknowledgements

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5. References

1. Okamoto, D.; Morita, S.; Taguchi, H.; Kim, Y. H.; Kotaka T.; Tateyama, H. Polymer 2000, 41, 4531.
2. Ramos, J.; Millan, A.; Palacio, F. Polymer 2000, 41, 8461.