이성분 복합방사 스펀본드부직포의 인장과 항균특성에 은나노 입자의 영향

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Effect of Nano-Silver Particles on the Tensile and Antibacterial Properties of Bicomponent Spunbond Nonwovens

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1. Introduction

In recent year, the antibacterial agents used industrial end-uses have included quaternary ammonium salt, metal salt solutions, and antibiotics. However, some of the agents such as quaternary ammonium salt, metal salt solutions, and antibiotics are toxic or poorly effective, which makes them not suitable for applications in filters and textiles, and for the exclusion of pollution. In contrast, silver is a non-toxic, non-tolerant disinfectant that can reduce many bacterial infections significantly. In this research, we have investigated strength and antibacterial properties of bicomponent spunbond nonwovens with different concentration of nano-silver particles.

2. Experimental

Filaments in the fiber web were composed of sheath/core types as the bicomponent structure. The amount of added nano-silver particles are individually 0.3, 0.5 and 1.0wt%. Sheath part of fiber was composed of low melted CoPET and core part was composed of regular melted PET. Characteristics of the produced samples are indicated in Table 1.

The SEM(JSM-6300, JEOL Ltd., Japan) was used to observe the morphological structure of samples. The tensile properties of samples were measured by tensile tester(Instron 4467). Antibacterial tests were carried out for the antibacterial effect of bico-spunbond nonwovens by the quantitative antibacterial test method. The tests were performed with two bacilli. It is *Staphylococcus aureus*(ATCC No 6538) and *Escherichia coli*(ATCC No 35922). The degree of antibacterial effect was presented as the reduction ratio for the bacilli.

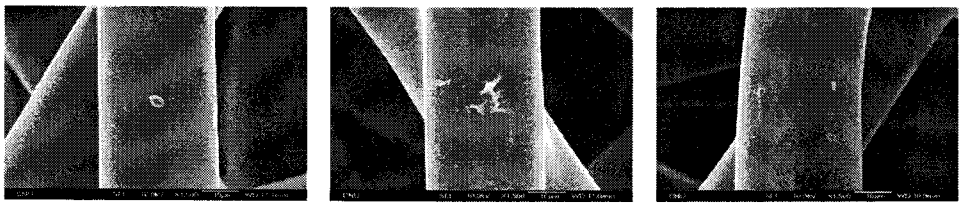
Table 1. Characteristics of bico-spunbond nonwovens with Ag content

Sample ID	Nano silver portion (wt%)	Basis weight (g/m^2)	Fiber diameter (μm)	Thickness (mm)
SS-1	0.0	98.0±5.77	31.7±4.43	0.8±0.10
SS-2	0.3	101.6±5.32	37.2±4.10	0.7±0.03
SS-3	0.5	99.8±12.31	38.9±3.44	0.8±0.04
SS-4	1.0	101.5±7.68	37.0±4.93	0.8±0.04

3. Results and discussion

3.1. Morphological structure

We obtained SEM micrographs(Figure 1) to observe the surfaces of the spunbond nonwovens added nano-silver particles. The nano-silver particles were generally well-dispersed on the surfaces of fibers.

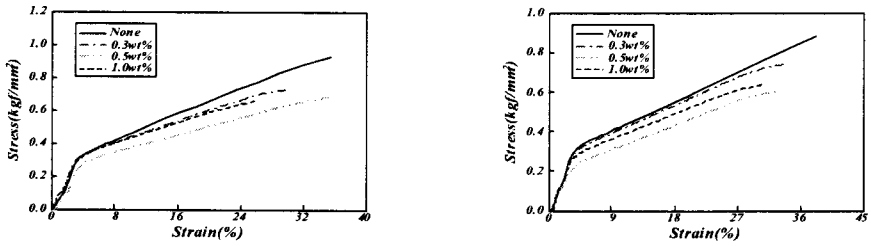


(a) 0.3wt% (b) 0.5wt% (c) 1.0wt%

Figure 1. SEM images of nonwovens with Ag content

3.2. Tensile properties

The tensile strength of spunbond nonwovens generally decreased with increasing of nano-silver particles content due to the instable molecular structure and the irregularity of fiber diameter.



(a) MD (b) CD

Figure 2. Stress-Strain curves of nonwovens with Ag content

3.3. Antibacterial properties

All of the specimens exhibited excellent reductions against *Staphylococcus aureus*, but there is not a clear effect of the nano-silver particle's amount. and the percentage reduction against *Escherichia coli* of SS-4 sample is larger than that of SS-2 and SS-3 samples.

4. Conclusions

From the experimental result of PET/CopET spunbond nonwovens with adding nano-silver particles, the tensile strength of samples decreased with increasing the amount of nano-silver particles. Also, the antibacterial effect of nano-silver particles on the nonwovens were significantly increased.

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