Filtration characteristic on different charging conditions of filter

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Nanofiber was broadly used in a variety of applications, such as filtration for air or water, tissue engineering scaffolds, protective clothing and biomedical application, etc. The nanofiber was provided with exceptional properties which included high specific area, high aspect ratio, and small pore diameter. The surface of electret filters has electrostatic attraction, as increasing the electricity, particle penetration will gradually decrease (Hanley et al., 1999; Nifuku et al., 2001).

In this study, the electrospinning and filtration system were set up as shown in Figure 1 (a) and (b). The nanofiber was produced from PMMA solution by electrospinning, and added high dielectric materials TiO_2 to assess the basic properties. Then, the penetration of charging filter was measured in the filtration system.

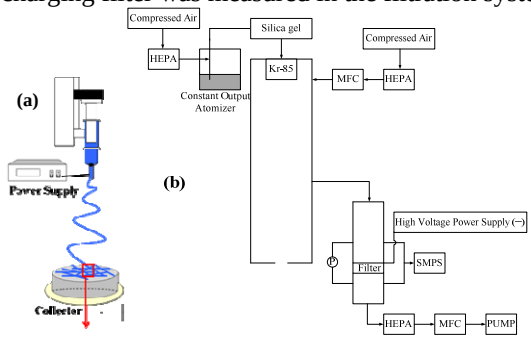

Figure 1. (a) The electrospinning system and (b) filtration system

Figure 2 (a) shows the SEM images of the PMMA/TiO_2 fibers. The uniform surface of the fiber was observed. It was also found the small amount of TiO_2 particles were attached on the fiber surface. Besides, the distribution of fiber diameters was calculated from SEM images, as shown in Figure 2 (b). The average diameter was 1062.73±126.04 nm.

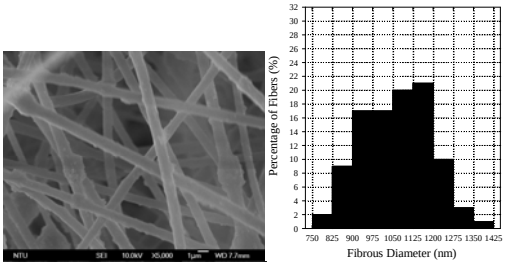

Figure 2. (a) SEM micrographs of the PMMA/TiO_2 fibers, (b) the distribution of fiber diameters.

The experiments used two conditions to charge the filter. One was pre-charge in just 5 minutes before filtration. The other was continuously charged during the filtration process. Figure 3 shows the comparison of the particle penetration between pre-charge condition and continuous charge condition for a long period of time. The thickness and packing density of testing filters were about 0.077 mm and 10.75%, respectively. The results indicated that the particle penetration decreased with increasing the period of filtration because the particles accumulated on the surface of the filter and loaded inside the filter during the filtration.

Moreover, the particle penetration of pre-charge condition was higher than continuous charge. It could be inferred that the charge time of pre-charge was too short to maintain the surface voltage of filter for a long time. Consequently, using the continuous charge for the filter could maintain the surface voltage so that the collection would more efficient.

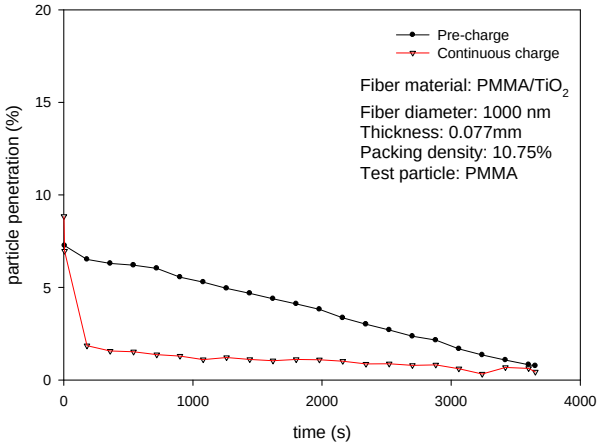

Figure 3. The comparison of the particle penetration between pre-charge condition and continuous charge condition for a long period of time

Hanley, J.T., Ensor, D.S., Foarde, K.K. and Sparks, L.E. (1999). *Proceedings of Indoor Air '99*, Edinburgh, Scotland.

Nifuku, M., Zhou, Y., Kisiel, A., Kobayashi, T. and Katoh, H. (2001) *J. Electrostat.* **51–52**: 200-205.