PE11) Bioaerosol Removal Efficiencies Using Silver Nano Particles Supported on Granular Activated Carbon

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1. Introduction

These bioaerosols released into the air in buildings result in many diseases such as anthrax, allergy, pneumonia, and so on(Zhang, 2004; Stetzenbach, 1998). Activated carbon has long been used for several purification processes including bioaerosol elimination. However, the bioaerosol removal by activated carbon is not completed and it is possible that the remaining of bacteria may adhere on the surface of GAC and grow by using pollutants as nutrients. In order overcome these problems, silver nano-particles have been proposed as an antibacterial agent on the surface of GAC. Silver or silver ions have long been known to have strong inhibitory bactericidal effects as well as a broad spectrum of antimicrobial activities. Silver particles in a nanometer size have a high specific surface area and a high fraction of surface atoms. It can be expected that high specific surface area lead to high antimicrobial activity compared to bulk Ag metal. It was proposed that silver nano particles act mainly in the range of 1~10nm attached to the surface of the cell membrane and drastically disturb microbial function including permeability and respiration(Liau, 1997; Solioz, 1995). Experimental evidences suggested that silver nano particles might penetrate inside the bacteria and caused further damages by possibly interacting with thiol groups in proteins, which induce the inactivation of the bacterial protein(Feng, 2000; Schreurs, 1982). Other studies have shown evidences of the formation of small electron-dense granules formed by silver. On the other hand, the antibacterial mechanisms have been partially understood. However, few studies have performed to assess the antibacterial property of silver nano-particles in contact with air. This study aimed to evaluate bioaerosoll removal efficiencies using silver nano particles supported on GAC(SNPs/GAC).

2. Material and Experimental

The silver nano particles were synthesized by a silver vapor deposition method by sputtering. In this study, the silver nano particles were deposited on GAC, and the final silver content in the GAC was 1000mg-SNPs/kg-GAC.

The bacterial culture of *E. coli* was diluted with a phosphate buffer saline(PBS) solution(3.5g KH_2PO_4; 4.3g K_2HPO_4; 8.5g NaCl per liter) to obtain a desired bacterial density of 10^4cells/m^3 at the inlet port.

The schematic of experimental apparatus is shown in Fig. 1. Bioaerosol, which was produced by an aerosol generator, was introduced into the column where contacted with GAC, SNPs/GAC, respectively.

Gas samples were taken from the inlet and the outlet port using mini-pump and membrane filters (Metricel Black, pore size of 0.45μm). The membrane filter samples were placed on nutrient agar plates, and were incubated for 48h at 25^0C. Then the survival amount of bacteria(cfu/m^3) was counted from the colony formed on the membrane filter. The removal efficiency rate was defined by Eq. 1.

$$\text{Removal efficiency} = 100 \times (CFU_{inlet} - CFU_{outlet})/CFU_{inlet}(\%) \quad (1)$$

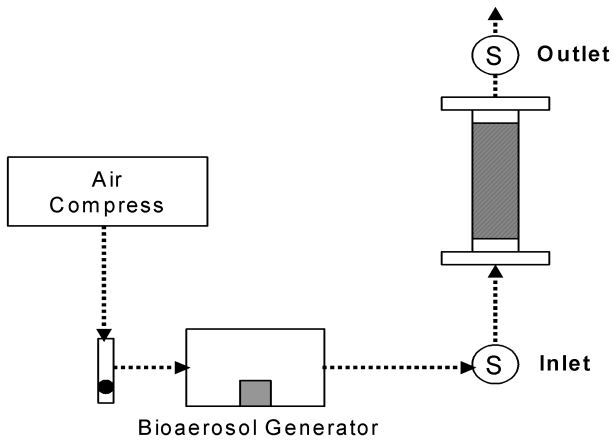

Fig. 1. Experimental setup.

3. Results and Discussions

Fig. 2 showed that the removal efficiency rates using SNPs supported on GAC always were higher than GAC without SNPs, were 94.8% and 80.8% in averaged, respectively. The result obviously indicated that SNPs were important in increasing bioaerosol removal efficiency. SNPs/GAC had a higher bacterial adsorption; event though the S_{BET} of SNPs/GAC decreased, this was due to the blockages of pores by SNPs.

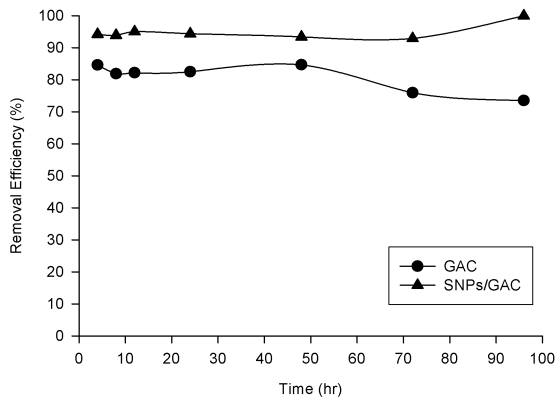

Fig. 2. Bioaerosol removal efficiencies using SNPs/GAC and GAC.

The amount viable cells on material(SNPs/GAC, GAC) were determined by taking some grains of SNPs/GAC(GAC) at different times. Viable cells were determined by the spread plate method with 0.1ml bacterial culture. Fig. 3 showed that the large amount of viable cells adhered on GAC and increased with time, whereas bacteria were completely inactivated on SNPs supported on GAC.

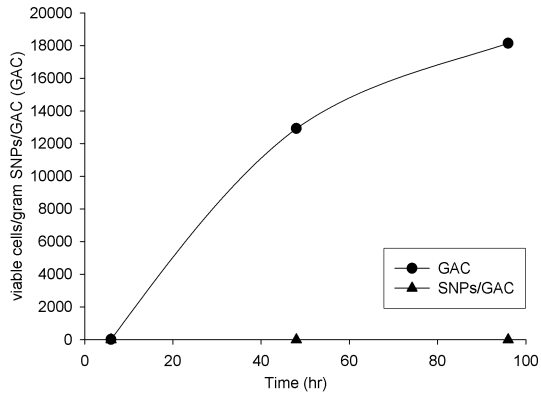

Fig. 3. Viable cells adhered on SNPs/GAC and GAC.

Acknowledgment

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