Evaluation of a Nanoparticle Generator for an Inhalation Toxicity Study of Silver Nanoparticle in SPF-SD Rats

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Abstract

The performance and characteristics of a nanoparticle generator for an inhalation toxicity study of silver nanoparticle in SPF-SD rats were investigated. The nanoparticle generator is evaporation/condensation type using the ceramic plate heater. At the constant carrier gas(clean air) flow rate, the nanoparticle size distributions with various temeperature conditions were measured by the SMPS system. The results showed that the geometric mean diameter and the total number concentration of nanoparticles increased with heater surface temperature. The particle generation was very stable since the temperature of heater surface was maintained uniformly with time.

1. INTRODUCTION

Recently, metal nanoparticles have been applied in the wide range of industrial fields, such as the quantum dot, the anti-biotic material, and the fuel cell, etc. However, chronic human exposure to high concentration of metal nanoparticles has been shown to induce adverse health effects, including neurological and respiratory problems. The present study describes a generator producing silver nanoparticles which we have developed for use in an inhalation toxicity study in SPF-SD rats.

2. METHODS

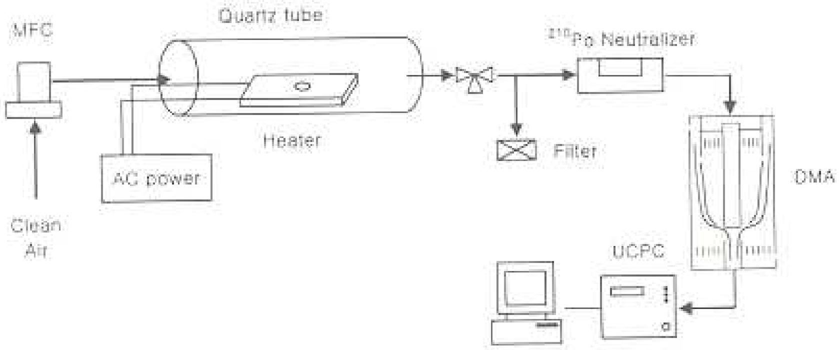

Figure 1. Experimental setup for the silver nanoparticle generation

The experimental schematic of this study is shown in Figure 1. The aerosol generation part consists of small-sized heater and quartz tube device case which contains the small-sized heater connected to AC power supply insides. The dimensions of the heater and the chamber are 50 x 5 x 1.5 mm^3 and Ø34 x 100 mm^3, respectively. The flat plate-type ceramic heater as small-sized heater was used. And, small-sized heater was heated by the AC power supply and was available for raising its surface temperature to about 1500℃ at the local heating area of 5 x 10 mm^2. The clean air was used as carrier gas and gas flow was kept at 4.0 Lpm by using mass flow controllers. At the various surface temperatures of heater (900 $<$ T $<$ 1500℃), the size distribution of synthesized nanoparticles can be measured directly by a DMA with a CPC connected to it.

3. RESULTS

The surface temperatures of the ceramic heater increased linearly with applied voltages. The particle generation was very stable since the temperature of heater surface was maintained uniformly with time. The Ag nanoparticles with high concentration were produced, which is stably generated for several hours. Because the ceramic heater has a short rising time of about 10 sec reaching to maximum temperature and the heater surface temperature did not fluctuate after the rising time, this method has the advantages of simple, speedy and stable process. The higher surface temperature gave the higher GMD, total number concentration and GSD.

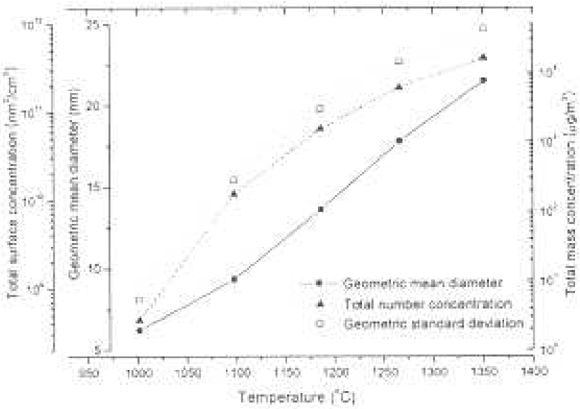

Figure 2. Variation of GMD, total surface and mass concentrations with temperature.

ACKNOWLEDGMENT

This work was supported by SAMSUNG ELECTRONICS CO., LTD.

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