Effect of air flow rate on the silver nanoparticle generation of an aerosol generator using flat plate type heater.

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INTRODUCTION

In recent year nano structured materials are used for many industrial applications. Silver nanoparticles are utilized in the new market in appliance. Nano-silver coating is applied on the inner surface of a product or on the filter to prevent the growth of fungi and bacteria.

Scheibel and Porstendörfer(1983) described a device based upon evaporation and condensation in tube furnace at atmospheric pressure with N₂-carrier gas. They studied particle generation as a function of furnace temperature, carrier gas flow rate, and position of the boat containing the metal. But the previous system needs sufficient space and high power consumption. We used a small-sized flat heater to evaporate a source material. During passing a chamber source material are converted to nanoparticles and grown by condensation process.

In this study we evaluated the effects of air flow rate for an aerosol generator with locally heated area in air stream. First, we measure the surface temperature of heated area in varying with air flow rate by infrared thermal imaging camera. Second, the characteristics of the particle generation were evaluated. We compared the particle size distribution and the surface temperature of the heater. To describe the difference of particle size distribution, finally, we analyzed the flow and thermal distribution near the heater surface by using CFD code, CFD-ACE.

EXPERIMENTAL METHODS

For the measure of surface temperature with varying air flow rate we used infrared thermal imaging camera (TH 3104MR, NEC San-ei Instruments). The flow rate is changed from 2, 4, 6 l/min at the fixed applying voltage. The emissivity of thermal parameter was corrected with different air flow rate since quartz tube was used as a parent cylinder wall.

The chamber length of the generator is 80 mm, diameter is 30 mm, and the heating area of heater is smaller than 5 x 10⁻² mm². The heating area of heater is limited with local region. The size distribution of the generated particle was measured by a SMPS system (nano DMA, TSI 3085 and UCPC, TSI 3025).

RESULTS AND DISCUSSION

Figure 1 shows the temperature distribution with axis direction of flat plate heater. The heating length is about 10 mm. The temperature of the heater edge, which was faced with air, decreases stiffly. The temperature decreases as the distance is far from heating area. Varying air flow rates the highest temperature of heating area was from 1058 °C to 1092 °C at the applied voltage of 80 V. The temperature difference between still air and 6 l/min was about 34 degrees. The thermal distribution of heating area was similar with varying air flow rate. However, the particle size distribution was changed with flow rates. The mean diameter decreases with increasing air flow rate. Using this particle generator we could obtain metal aerosol with high concentrations (≥10⁷ particles/cm³).

Keywords: aerosol generator, nano particle, evaporation/condensation

REFERENCES