Silver Nano-particle Generation Using Ion Nuclei in a Supersonic Nozzle

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Abstract

The silver nano particle generation using ion nuclei was evaluated in a supersonic nozzle. For generating ion, we applied the sonic-jet corona discharge method. The corona ions act as nuclei for the silver vapor condensation and generated particles are charged unipolarly. The TEM(Transmission Electron Microscope) analysis of particles showed that the repulsive coulomb force between charged particles reduces their coagulation rate and produces non-agglomerated and charged nano particles.

1. INTRODUCTION

Recently, metal nano particles have been applied in the wide range of industrial fields, such as the quantum dot, the anti-biotic material, and the fuel cell, etc.. In most of the applications, The morphological shape and the physical properties of the particles should be well controlled for successful adaptation. In this study, we have generated charged silver nano particle using ion nuclei in supersonic nozzle. For ion nuclei, we used the sonic-jet corona discharge method and the preparation conditions, such as, the deposition time, ion nuclei number concentration, reaction power are changed.

2. METHODS

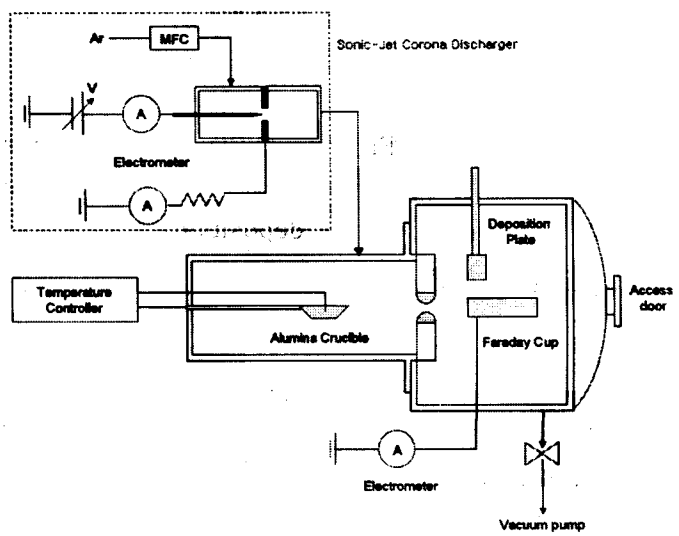
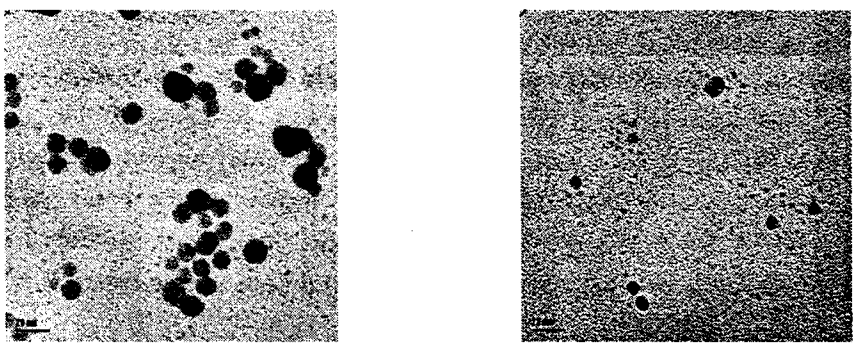


Figure 1. Experimental setup for charged silver nano particle generation

The experimental schematic of this study is shown in Figure 1. This equipment consists of three parts; an evaporation chamber for generating silver vapor, a deposition chamber for collecting and measuring charge of generated particle, and sonic-jet corona discharger for generating the ion nuclei. The Ar gas is used as carrier gas and ion nuclei source. The silver vapor is condensed on the Ar positive ion nuclei, and it is converted to nano particle through the supersonic nozzle expansion. The silver vapor is generated through hot wire method and hot wire generator power is about 20watt constant at the evaporation chamber pressure of 7.0torr and deposition chamber pressure with 0.7torr, respectively.

3. RESULTS

The silver nano particles were generated with and without the sonic-jet corona discharger at the fixed thermodynamic conditions. As shown TEM images in Figure 2, the smaller particle was obtained with ion supply. With/without the ion supply, the mean diameter of particles was 15nm and 9nm, respectively. And the generated particle had spherical morphology in both cases. In order to investigate the nature of the produced particles, the XRD analysis of silver nano particle was obtained as shown in Figure 3.



(a) (b)

Figure 2. TEM photographs ; (a) without ion nuclei, (b) with ion nuclei at fixed thermodynamic conditions; 7.0torr for evaporation chamber, 0.71torr for deposition chamber

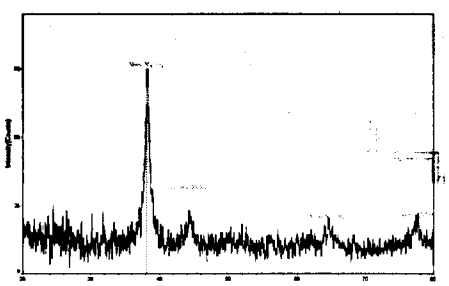


Figure 3. XRD analysis with silver elemental peaks ; the same thermodynamic condition, 30min deposition

REFERENCES

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