Anti-agglomeration of spark discharge generated aerosols via unipolar air ions

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Keywords: spark discharge, agglomeration, charged particle, moment method.
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This paper reports the effect of air ion on reducing agglomeration of metal aerosol particles generated from homogeneous spark discharge. For air ion generation, a carbon fiber ionizer was located right above the spark channel formed between two metal electrodes. Once the air ions were generated, they were directly delivered to the particles and charged the particles.

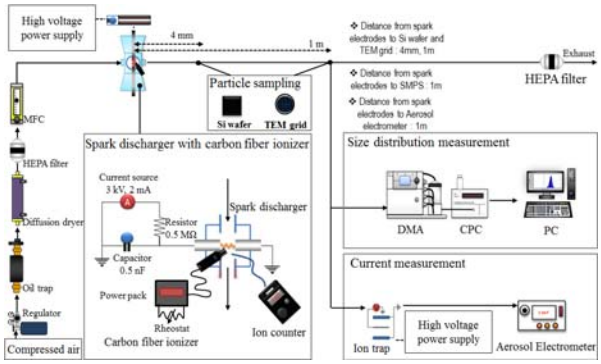

Figure 1. Schematic of experimental setup

In this study, a theoretical approach was carried out to predict the particle size distribution with time. For this purpose, the Brownian coagulation theory between charged particles was connected with the moment method. The particle size distribution was characterized by the scanning mobility particle sizer (SMPS) system and compared with the theoretically determined size distribution where results of current measurement, and transmission electron microscopy (TEM), and scanning electron microscopy (SEM) were used (Figure 1).

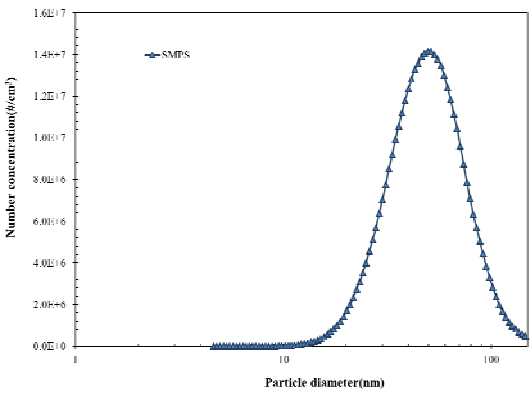

Figure 2. Size distribution of spark generated particles

Experimental results were in good agreement with calculations by the moment method. The particle size right after the spark generation was about 4 nm. Then, the size increased to 50nm at 1m downstream (residence time of 1.76sec) from the spark channel owing to Brownian agglomeration, when there were no air ions injected (Figure 2).

However, with the injection of air ions (ion concentration : particle concentration = 10 : 1), the size of particles was reduced to be around 10 nm due to the repulsive force between unipolarly charged particles with an average charge number of 0.39 (Figure 3).

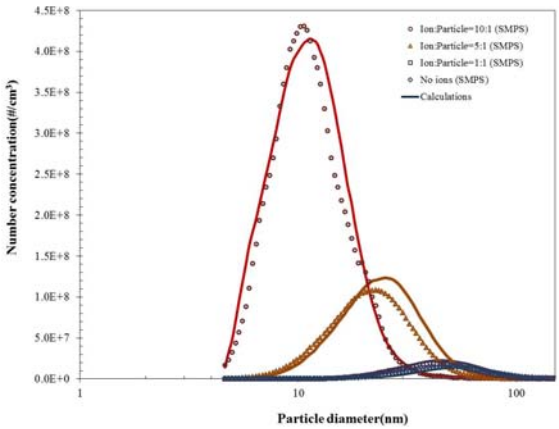

Figure 3. Effect of air ions on particle size distribution

This research was supported by Future-based Technology Development Program (Green Nano Technology Development Program) through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (grant number 2011-0030206)..

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