

An ESP nanoparticle generator

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Electrostatic precipitators (ESPs) are devices commonly used to remove charged particles in gas by electrostatic force. It is characterized by high collection efficiency, low pressure drop and low maintenance requirements (Mizuno, 2000). These devices originally designed for dust collection was found to generate particles under specific operating conditions. The transition from electrostatic precipitation to nanoparticle generation has been thoroughly investigated (Lin et al., 2012). This unique feature was utilized in the present study to develop a nanoparticle generator based on corona discharge.

A lab-scale wire-plate type positive corona discharger was built for characterizing the aerosol emission from this ESP nanoparticle generator, as shown in Figure 1. Environmental contaminants were removed by HEPA filter, active charcoal and silica gel. Gold, tungsten, molybdenum, and stainless steel were used as the electrode to study the material dependency. Gas temperature was controlled by a feedback heater. A positive direct current power supply was employed to energize the corona discharger. A scanning mobility particle sizer with a nano differential mobility analyzer was employed to measure the aerosol number concentration and size distribution. Ozone concentration was monitored by using an ozone analyzer. The sampling locations of SMPS and ozone analyzer were 20 and 15 cm downstream the corona discharger, respectively. The major operating parameters included electrode diameter, electrode spacing, air velocity, air temperature, applied voltage and current.

Sputtering on the corona discharger was the principal mechanism of aerosol generation. Aerosol concentration increased with increasing electric field strength when the applied voltage was higher than the onset voltage, and decreased rapidly when the electric field strength exceeded a specific value. The maximum aerosol concentration occurred when the electric field strength was around 8.2, 9.8, and 11.2 kV for electrode diameter of 0.1, 0.2 and 0.3 mm, respectively. The smaller discharge electrode diameter generated more aerosol particles, but lower ozone concentration when compared to larger electrode diameter. The differences in aerosol concentration due to the change of electric field strength decreased with increasing electrode diameter, because the mean kinetic energy was more uniform in the larger electrode. Electrode materials did not affect the I-V

curve but the aerosol generation rate and the ozone concentration were clearly material-dependent. Gold was chosen as the discharge electrode because of stable and high sputtering yield.

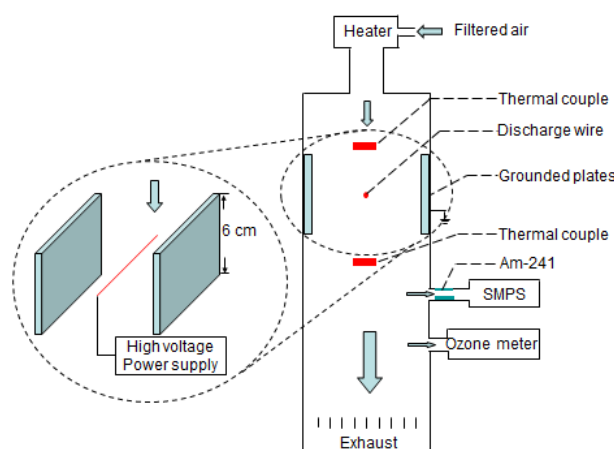


Figure 1. Schematic diagram of the experimental setup.

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Mizuno, A. (2000). *IEEE Transactions* 7, 615-624.