Characterization of an ion jet unipolar electrical aerosol diffusion charger

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In aerosol physical mechanics, the electrostatic force is one of the most important effects (Hinds, 1999). Charging of nanoparticle is an important project of study within some different areas such as aerosol measure, ultra-fine particle control and material synthesis. Particularly, nanoparticle is difficult to be charged with field charging alone. In the case of relatively large particles, bipolar chargers are sufficiently efficient and produce a more or less well known equilibrium charge distribution. If the particle size is smaller, the charged particles with ions of opposite polarity becomes neutral particles (i.e. neutralization) (Alonso et al., 2006). A simple method is passed a unipolar ion cloud without electrical field from the DC corona discharge. Loss of charged particles is avoided if the aerosol flow passes a cloud of unipolar ions (Marquard et al., 2006). Therefore, this study focuses on the investigation of nanoparticle charge for a unipolar electrical aerosol diffusion charger, especially paying attention to the particle loss and the average number of elementary charges.

In this study, an ion jet unipolar electrical aerosol diffusion charger test system was set up, which is shown in figure 1. There are three main parts of this study: monodisperse aerosol generator system, charge chamber, and measurement system. A constant output atomizer was used to generate particles. The differential mobility analyzer (DMA) is widely used to generate monodisperse aerosol. Besides, the aerosol concentration was measured with an SMPS and the number of elementary charges was calculated with an aerosol electrometer.
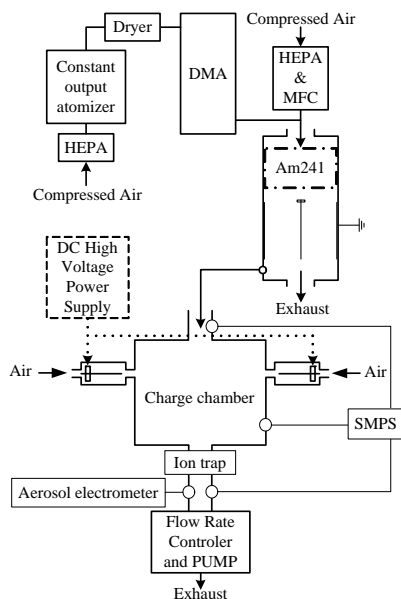

Figure 1. Schematic diagram of test system.

The result of figure 2 shows that the average number of elementary charges increased if particle size and jet flow rate becomes larger. In addition, there is no electric field loss in this charger. Just only has the charged loss (figure 3) which is calculated with $\eta_e = 1- \exp[- (24 \kappa)^{1/3}]$. The charged loss was increased as the particle size increased. Beyond that, the concentration of particles is diluted with the jet flow of unipolar electrical aerosol diffusion charger (figure 4) irrespective of the size of particles.
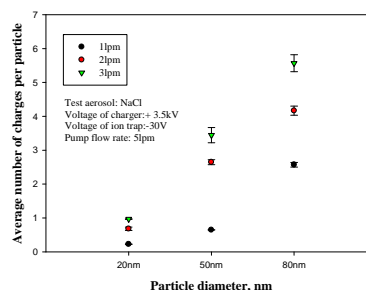

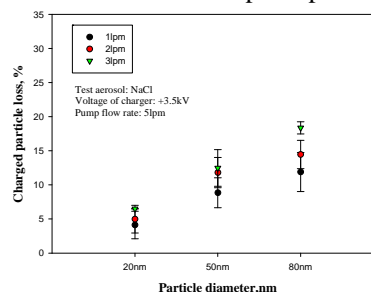Figure 2. The average number of elementary charges of three different monodisperse particles.

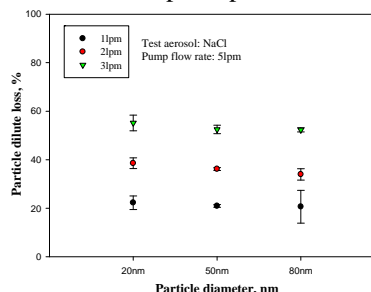Figure 3. The charged particle loss of three different monodisperse particles.

Figure 4. The diluted loss of three different monodisperse particles.

William-C Hinds, (1999), "Aerosol Technology," *New York: WILEY-INTERSCIENCE.*

Alonso, M. Martin, M.I. and Alguacil, F.J. (2006) *Journal of Electrostatics*, Vol.64:3-4, pp.203–214.

Marquard, A. Meyer, J. and Kasper, G. (2006) *Journal of Aerosol Science*, Vol.37:9, pp.1069–1080.