# Charging efficiency of the single-wire corona unipolar charger with radial sheath flow

V. Wattanamekhinkul[1], C.L. Chein[1] and C.J. Tsai[1]

[1]Institute of Environmental Engineering, National Chiao Tung University, Hsinchu, 30010, Taiwan
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Presenting author email: w_virat@yahoo.com

A single-wire corona unipolar charger has been developed and investigated to enhance the extrinsic charging efficiency of nanoparticles by using radial sheath air to minimize charged particle loss. Experimental charging efficiencies were obtained at a fixed aerosol flow rate of 0.5 and 1.0 L/min using monodisperse silver nanoparticles of 2.5 to 20 nm in diameter. The applied sheath air flow rates range from 0.5 to 2.0 L/min, while the applied corona voltage range from ±1.80 to ±2.70 kV respectively.

Figure 1 shows the schematic diagram of the present unipolar charger which is a modification of the nanoparticle charger with multiple discharging wires developed by Tsai et al. (2010) and the nanoparticle charger with sheath air developed by Chien et al. (2011). The outer stainless steel cylindrical casing of 30 mm in diameter is grounded. A 6 mm long grounded porous metal tube (inner diameter ID = 6.35 mm) with a Teflon tube inserted at the end from which radial sheath air is introduced, and a discharge gold wire of 50 µm in ID and 6 mm in effective length is used as the discharge electrode, on which a high DC voltage is applied from the top of the charger. The space between the gold wire and the stainless steel casing is the charging zone where aerosol charging takes place.

The aerosol flow is introduced into the charger from the top aerosol inlet through an annular slit of 0.05-mm gap formed by the stainless steel shroud and the outer casing, and filtered high-speed sheath airflow with the velocity of 0.07–0.28 m/s is introduced through the inner wall of the porous tube to avoid charged particle loss. The charged particles are accelerated to exit the charger quickly through the bottom aerosol outlet after the charging zone.

Four parameters are used for the performance evaluation of unipolar electrical aerosol chargers (Marquard et al. 2006), including intrinsic charging efficiency ($\eta_{int}$), extrinsic charging efficiency ($\eta_{ext}$), electrostatic loss ($L_{el}$), and diffusion loss ($L^0_d$ ).

The obtained experimental data will be used to validate with numerical results of Chien and Tsai (2012) which shows that the extrinsic charging efficiency ranges from 17.2% - 70.5% for particles ranging from 2.5 to 10 nm in diameter.

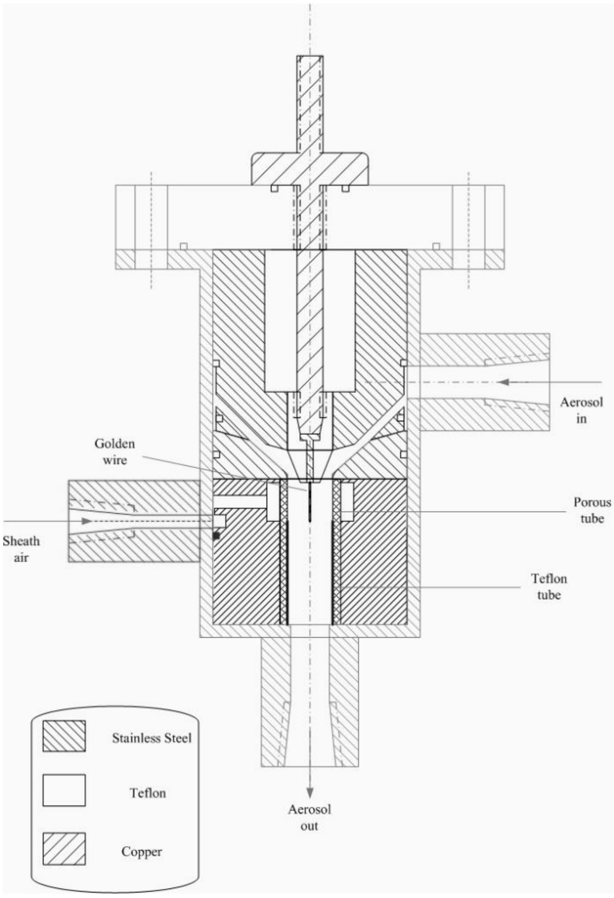


Figure 1. Schematic diagram of the present unipolar charger

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