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Determination of Air Filter Collection Efficiency for Nanoparticles with Macromolecular Ions

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Threshold size of nanoparticle at which thermal rebound takes place has been of great concern for decades. The determination of threshold size largely depends upon the generation of monodispersed nanoparticles and their detection. Electrospray (ES) of macromolecular ions may serve to generate uniform sub-10 nm particles. In the present work, we investigated the characteristics of macromolecular ions generated by ES as a test aerosol for measuring collection efficiency of nanoparticles. Polyethylene glycols (PEGs) were selected as a macromolecule. The collection efficiency of a SUS screens was measured in three different charge states, i.e., multiply charged, singly charged, and equilibrium charged. The particle concentration was measured with an ion counter or CPC, and the particle penetration was determined from the concentration ratio at the outlets of two filter holders. The tandem DMA method revealed that PEG particles generated by ES have very sharp electrical mobility distribution but they consist of multiply-charged macromolecular ions. Therefore, if we convert the electrical mobility to the particle size assuming that they would carry only an elementary charge and calculate Peclet number, *Pe*, then the single fiber collection efficiencies plotted against *Pe* are much lower than the predicted by pure diffusion theory. The single fiber collection efficiencies of singly-charged and equilibrium-charged PEG particles fall on the theoretical line, suggesting that there is no influence of electrical charge on the collection of PEG particles and that the single fiber efficiencies of PEG particles with the diameter down to 2.7 nm are in agreement with the

prediction.