Development and Characterization of a Portable Instrument for the Measurement of the Size and Number of Airborne Nanoparticles

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Nanoparticle emissions in motor-vehicle exhaust are associated with cardio-pulmonary health impacts and increased mortality. The emission, evolution, and exposure-uptake of these particles is fundamentally quantified by the number distribution as a function of particle size. Nanoparticle size distributions are widely varying and fast changing, as they are strongly influenced by local environmental conditions and variation in vehicle operation and maintenance. Thus, to conduct research and establish regulation necessary to quantify and control such emissions, many measurements of the number/size distribution of nanoparticles in vehicle exhaust and by the roadside are needed. Instruments are available to make such measurements, but are mostly expensive, non-portable, and have slow response times. Research to develop and characterize an inexpensive, portable, and fast-measuring instrument designed to meet this need, the NanoAPA, is presented. The instrument performs nanoparticle sizing and counting through electronic control of a microfabricated device that charges sampled airborne particles with a corona ionizer and then incrementally collects and counts the number of particles from 10 to 100nm in a serial-condenser aspiration capacitor utilizing voltage-and-flowrate-variable electrophoresis. Characterization of instrument function is presented for exhaust-analog particles of oleic acid and emery oil.