

C N Davies Award Year 1 Report

Background - Direct ultraviolet (UV) photoionization enables increased electrical charging efficiency of some aerosol nanoparticle materials over alternative charging mechanisms such as diffusion charging. The aim of my research is to understand the fundamental photoionization mechanisms, particle/ion interactions and transport of nanoparticles in order to refine a detection method for nanoparticle geometric parameters in an aerosol flow. The results of my research will be commercialized in an environmental or personal exposure monitoring device.

Year in Review - In the past year I have developed a strong foundation of understanding based on theoretical and numerical analyses which will allow me to focus my remaining experimental work. The two main research goals I accomplished in the past year were to 1) develop analytical and numerical techniques to study the charging and transport mechanisms underlying the aerosol particle measurement device, and 2) compare results from the model with experiments to provide some validation of the modelling techniques. To accomplish the first goal, I developed the first 3D computational model which includes photoionization, recombination, diffusion and electrical field transport of multiply-charged particles through a steady state control volume and which is directly applicable to the development and operation of the nanoparticle sensor. For the second goal, I photoionized soot particles and, by applying a low strength electric field, measured the level of particle and ion charging through electrical current measurements. I showed quantitative agreement for measured signal when comparing the model and experiment and demonstrated the ability to yield soot size and concentration parameters. I have shared my efforts widely with the aerosol communities and will continue to do so. Some highlights from 2016 are:

- Presented poster at *UK Aerosol Society Focus Meeting 8*, Apr. 5, 2016, London, UK (Best Poster Award)
- UK Patent application submitted
- Co-organised *Cambridge Particle Meeting*, June 10, 2016, Cambridge, UK
 - annual event bringing together 100 academics and industrial participants to discuss emissions, after treatment technologies, measurement principles and device design.
 - promoted UK Aerosol Society with banner and leaflets
- Presentation (Dr. Boies) on modelling of charging and transport mechanisms at *22nd European Aerosol Conference*, September 4-9, 2016, Tours, France
- Presented on experimental validation of modelling techniques at *American Association for Aerosol Research 35th Annual Conference*, October 17-21, 2016, Portland, USA
 - made possible by a travel grant from the UK Aerosol Society
- Published paper on modelling of particle charging and transport mechanisms in *Journal of Applied Physics* DOI: 10.1063/1.4972335
- Attended Fundamentals of Aerosol Science Course and Annual Aerosol Society Conference, November 9-10, 2016, Birmingham, UK