

Public Abstract

First Name:Matthew

Middle Name:Paul

Last Name:Simones

Adviser's First Name:Sudarshan

Adviser's Last Name:Loyalka

Co-Adviser's First Name:

Co-Adviser's Last Name:

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Title:Measurement of Coagulating Silver and Carbon Aerosols Using a Tandem Differential Mobility Analyzer

The high temperature gas-cooled reactor (HTGR) has been identified by the Generation IV International Forum as a possible candidate for future advanced nuclear reactor designs. The HTGR has a target outlet temperature of 1000 °C which allows for the production of electricity at high thermal efficiency, as well as the production of hydrogen via thermochemical processes. One of the unresolved technical issues associated with HTGR is the production of carbonaceous dust (e.g. by abrasion, corrosion, radiation damage, gas-to-particle conversion) and the subsequent transport of sorbed fission products via aerosol transport. Diffusion charging and/or self-charging of these aerosols is likely to occur which will affect how the aerosol evolves in time and ultimately deposits on surfaces. At present, nuclear reactor safety codes, such as MELCOR, do not account for these electrostatic effects and there is currently no consensus on their importance. Further experimentation and modeling of these effects are therefore important and ongoing to resolve these issues.

The purpose of this research is to experimentally investigate the coagulation of charged aerosols closely associated with HTGRs by measuring the evolution of size and charge distributions over time and to compare the experimental results with available numerical models. To complete these objectives a tandem differential mobility analyzer has been set up and calibrated for the measurement of aerosol size and charge distributions, and an open flow coagulation chamber has been designed and constructed to facilitate monitoring the coagulation process. Measurements have been completed for both silver and carbon ultrafine aerosols and simulations have been completed for a numerical model by employing both the sectional and direct simulation Monte Carlo technique. In both cases the results indicate that coagulation occurs faster than predicted by the model, at times differing by an order of magnitude. Overall, the apparatus developed here will support future coagulation studies of charged ultrafine aerosols at the Nuclear Science and Engineering Institute by providing data for validation of computer codes and guiding model development.