DEPOSITION OF AEROSOLS IN CYLINDRICAL TUBES AND IN HUMAN LUNG AIRWAYS

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ABSTRACT

Aerosol transport and deposition is of interest in many industrial and medical applications. This research is focused on two specific topics: deposition of aerosols in cylindrical tubes with emphasis on thermophoresis and deposition in real human lung airways.

A numerical technique and a CFD code FLUENT are explored and used to estimate particle deposition efficiency due to thermophoresis in cylindrical tubes. Discrete phase modeling (DPM) employing Lagrangian particle tracking algorithm in CFD code FLUENT and user defined functions for thermophoretic force were used to predict the particle deposition efficiencies. Further, limited experiments were conducted to measure the thermophoretic deposition efficiency of carbon nanoparticles in a cylindrical tube.

Real lung airway geometry for computational purposes was developed using Computed Tomography (CT) scan images of chest. Using image segmentation, volume rendering and surface processing tools in two commercially available software programs, the real lung airway surface geometry was extracted with good anatomical detail. Particle deposition was modeled using species transport and reaction modeling for molecular phase radioactive polonium-218 species in air. DPM model was also used to compute deposition of particles inhaled in the real lung airway geometry. The computational models used were verified against available experimental data for simpler single bifurcation geometries. Particle deposition efficiencies were computed using the DPM model for carbon nanoparticles of sizes 100 to 1000 nm.