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Deposition fraction of ellipsoidal fibers in a model of human nasal cavity for laminar and turbulent flows

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In this study, the deposition fraction of ellipsoidal fibers in a realistic model of a human nasal cavity was evaluated for laminar and turbulent airflow conditions. The mean flow field was simulated by solving the discretized continuity and Navier-Stokes equations using the ANSYS-Fluent software. For ellipsoidal particle trajectory analysis, several user defined functions (UDFs) were developed and coupled to the ANSYS-Fluent discrete phase model (DPM). The presented formulation accounted for the coupled translation and rotational motions of ellipsoidal fibers and included the stochastic modeling of turbulence velocity and velocity gradient fluctuations. Particular attention was given to the proper modeling of turbulence fluctuation fields especially in the near wall region for accurate evaluation of fiber deposition rate. The predicted fiber deposition fractions in the nasal passage were compared with the available experimental and numerical results for both laminar and turbulent flows and good agreement was observed.

Keywords: Nasal cavity, Ellipsoidal particles, Deposition fraction, Laminar flow, Turbulent flow