Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Simulations of the Motion of Arbitrarily Shaped Fibers in a Linear Shear Flow[1] ANDRIY ROSHCHENKO, Department of Mathematical and Statistical Sciences, University of Alberta, WARREN FINLAY, Department of Mechanical Engineering, University of Alberta, PETER MINEV, Department of Mathematical and Statistical Sciences, University of Alberta — Fibrous airborne particles cause severe adverse health effects when inhaled and deposited in human lungs. For this reason, fiber deposition in the lungs has been studied by numerous authors. However, a complete mechanistic model of fiber dynamics in the lungs has not yet been presented. One of the problems yet to be addressed involves the dynamics of arbitrarily shaped fibers in the lungs. Here, a two-grid fictitious domain method was used for direct simulations of arbitrarily shaped high aspect ratio fibers in linear shear flow, including an improved microscale grid resolution scheme and a Lagrangian-Eulerian approach whereby we transform the equations from a laboratory coordinate system to one fixed with the microgrid. Our simulations show the expected Jeffery orbits for straight, symmetric fibers. However, for asymmetric fiber shapes we observe a surprising secondary rotation that is out of the shear plane. Our findings suggest that studies of deposition efficiencies of fibrous aerosols should account for possible increases in deposition due to asymmetrical aerosol particles or their aggregations.

[1]Sponsored by NSERC Discovery Grant.

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Date submitted: 30 Jul 2010 Electronic form version 1.4