The Role of Variable Zeta Potential and Enhanced Diffusiophoresis Via Time-Varying Solute Gradients

MAE SEMINAR SERIES

Thursday,
September 29
3:30 p.m.
104 Knox Hall

PRESENTED BY

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ABSTRACT:

Here, we consider the coupled dynamics of solutes and charged colloidal particles in confined geometries. First, we consider the diffusiophoresis of particles in a Taylor-dispersing solute and show that the cross-stream gradients generate significant 2D and 3D effects on the particle transport. We extend this work by considering the analog of Taylor dispersion in a channel with no shear- or pressure-driven flow under the simple action of a diffusing solute. When the channel walls are charged, the solute diffusion drives a diffusioosmotic wall slip condition that can in turn drive a recirculating flow that can enhance the solute diffusion. Next, we consider the role of variable zeta potential and the proper selection of both zeta potential and diffusiophoretic/diffusioosmotic mobility models on the prediction of particle/solute motions in confined systems and propose several approaches for selecting the best model. Finally, we consider the significant role of 3D effects on particle motions in quasi-1D solute concentration gradients by considering merging solute streams via high-fidelity 3D numerical simulations. If time allows, we will also comment on the ability to enhance diffusiophoretic extraction of particles from a dead-end pore by incorporating time-varying solute concentration strategies.

BIO SKETCH:

Jesse Ault received his BSME from Purdue University in 2012 and his PhD from Princeton University in 2017 under the advising of Professor Howard Stone. He spent two years at the Oak Ridge National Laboratory as an Alvin M. Weinberg Distinguished Fellow in the Computational Sciences and Engineering Division before joining the Fluids and Thermal Sciences Group in the School of Engineering at Brown University in 2019. Jesse's research interests are at the intersection of applied mathematics, high-performance computing, and coupled fluid/particle/solute transport phenomena. His recent research has emphasized the manipulation of such coupled transport dynamics to manipulate suspended colloidal particles and biomaterials.

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