NUMERICAL ADVANCES IN ELECTROPHORETIC DEPOSITION OF FLOW CELLS

Miguel Salazar de Troya, Lawrence Livermore National Laboratory, USA
salazardetro1@llnl.gov
Brian Giera, Lawrence Livermore National Laboratory, Livermore, USA
Andrew Pascall, Lawrence Livermore National Laboratory, USA

Key Words: finite element modeling, simulation, electrophoretic deposition with flow

Modeling of electrophoretic deposition (EPD) has generally been restricted to a set of idealized geometries and processing conditions by using analytical approaches. While mesoscale models yield exquisite particle-level details of deposits [1,2], these high powered computational methods only allow for simulations across limited time and spatial scales. The Finite Element Method (FEM) solves a coupled system of nonlinear partial differential equations that capture physics relative to a given EPD application. With this approach, it is possible to simulate EPD over empirically relevant timescales for arbitrary geometries without spatial resolution afforded by mesoscale modeling. In this talk, we present numerical simulation results of the EPD of a flowing suspension within a custom cell in experimentally relevant time and spatial scales. We resolve the multiphysics coupled problem using the finite element method and compare the deposit morphology with experimental results of a similar system. Additionally, we interrogate the evolution of the deposit in simulations and the empirically-inaccessible particle velocity field to reveal the mechanisms of formation for the various deposit morphologies. We also cast these trends in terms of the dimensionless parameters to provide intuition on how to achieve a desired deposit morphology with the electrophoretic deposition flow cell. LLNL-ABS- #1011150

[1] Giera, B.; Zepeda-Ruiz, L. A.; Pascall, A. J.; Kuntz, J. D.; Spadaccini, C. M.; Weisgraber, T. H. Mesoscale Particle-Based Model of Electrophoresis. Journal of the Electrochemical Society. The Electrochemical Society 2015, pp D3030–D3035.

[2] Giera, B.; Zepeda-Ruiz, L. A.; Pascall, A. J.; Weisgraber, T. H. Mesoscale Particle-Based Model of Electrophoretic Deposition. Langmuir 2017, 33, 2, 652-661

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 LLNL-ABS-XXXXX.