Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Direct numerical simulations of semi-dilute and concentrated suspensions of non-conductive particles in an electric field.[1] SIAMAK MIRFENDERESKI, JAE SUNG PARK, University of Nebraska - Lincoln — The electrical manipulation of particles dispersed in a host fluid is known to be the basic concept of electrorheological (ER) fluids. Under the action of an electric field, the ER fluids in which non-conductive but electrically active particles are suspended in an electrically insulating fluid, are known to undergo dielectrophoretic (DEP) interactions and exhibit a dramatic viscosity enhancement. It is well-known that DEP interactions between the particles lead to a rapid formation of particle chains along the field direction. The fibrillated structures are responsible for the unique rheological properties of ER suspensions and tend to be thicker with volume fraction. However, the response of ER suspensions to an electric field at high concentrations has yet to be fully studied. In this study, we perform large-scale Stokesian dynamics simulations to study the semi-dilute and concentrated suspension of non-conductive particles in an electric field. It is found that the kinetics of pattern formation changes above a volume fraction of 0.35 at which a suspension directly undergoes mesoscale structure formation. The electric stress field of suspension is presented for a range of volume fractions. Lastly, the effect of confinement on suspension dynamics is discussed.

[1]This work was supported in part by the National Science Foundation, Grant No. CBET-1936065.

Siamak Mirfendereski
University of Nebraska - Lincoln

Date submitted: 29 Jul 2020 Electronic form version 1.4