Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

New Electric Field-Driven Mesoscale Phase Transitions in Polarized Suspensions ANIL KUMAR, ANDREAS ACRIVOS, ZHIYONG QIU, The Levich Institute, BORIS KHUSID, New Jersey Institute of Technology — We report the discovery of a new electric-field induced mesoscale phase transition in a confined suspension under the action of a spatially uniform AC electric field (∼kV/mm, 0.1-3kHz). The experiments were conducted on suspensions of neutrally buoyant, negatively polarized, non-Brownian particles confined between two parallel electrodes. Within few seconds following the field application, as expected, the particles align themselves along the field direction forming chains and columns. But, surprisingly, after ∼10-20 minutes, several nucleation sites suddenly appeared throughout the whole experimental cavity. At these nucleation sites, the particle columns, formed initially, began moving radially outward until they interfered with one another at which point they created a stationary cellular pattern. We characterized the morphology of this pattern and found that it depended only on the initial suspension concentration and the interelectrode gap. The growth kinetics of the structure formation was governed only by the initial particle concentration and the magnitude of the applied field strength. Strangely, both the morphology as well as the kinetics, are insensitive to the particle size and the field frequency. Lastly, we wish to note a surprising similarity of the observed cellular structure formation and a hotly debated paradoxical scenario of multi-scale phase transitions proposed by Lebowitz and Penrose nearly 40 years ago.

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Date submitted: 23 May 2005 Electronic form version 1.4