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Observations of the initial stages of colloidal band formation[1]
YANRONG LI, Ibaraki University, YOSHIYUKI TAGAWA, Tokyo University of Agriculture and Technology, ANDREW YEE, MINAMI YODA, Georgia Institute of Technology — A number of studies have shown that particles suspended in a conducting fluid near a wall are subject to wall-normal repulsive "lift" forces, even in the absence of interparticle interactions, in a flowing suspension. Evanescent-wave visualizations have shown that colloidal particles in a dilute (volume fractions <0.4%) suspension are instead *attracted* to the wall when the suspension is driven through $\sim 30\,\mu$m deep channels by a pressure gradient and an electric field when the resulting combined Poiseuille and electroosmotic (EO) flow are in opposite direction, *i.e.*, "counterflow," although the particles and channel walls both have negative zeta-potentials. Above a minimum "threshold" electric field magnitude $|E_{\min}|$, the particles assemble into dense "bands" with cross-sectional dimensions of a few μm and length comparable to that of the channel (*i.e.*, a few cm). The results suggest that the threshold field $|E_{\min}|$ is large enough so that there is a region of "reverse" flow, along the direction of the EO flow, near the wall. Visualization of a large segment of the channel (>300 hydraulic diameters) at frame rates as great as 1 kHz is used to determine banding maps for a variety of dilute colloidal suspensions and to investigate the initial stages of band formation over a wide range of flow conditions.

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