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Clustering and state diagram of charged colloids with short-range attraction in shear flows ALESSIO ZACCONE, Cavendish Laboratory, University of Cambridge, MASSIMO MORBIDELLI, Department of Chemistry, ETH Zurich — Under static conditions, the superposition of short-range (e.g. van der Waals) attraction and electrostatic repulsion gives rise to interesting phases such as equilibrium clusters in globular protein suspensions. What is much less understood is their behavior under external flow, which is important for the physiological aggregation of proteins and for industrial systems as well. I will present theoretical and experimental results showing that clustering of these systems in shear flow is characterized by the crossover from a reaction-limited clustering kinetics at low shear into a convection-dominated aggregation regime at high Peclet numbers. The kinetics may rise by up to many orders of magnitude in the crossover regime. This behavior is due to the singularly-perturbed character of the governing diffusion equation where the shear drift term induces a singularity and a boundary-layer at large interparticle distances. This understanding, together with a theoretical description of cluster breakup, is used to rationalize the peculiar nonequilibrium state diagram (including gelation) of these colloidal suspensions in shear flow with applications ranging from microfluidic self-assembly to proteins.

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