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Adhesion, Deformation, Rolling, and Detachment of a Liquid Capsule on An Adhesive Surface In Shear Flow VIJAY PAPPU, PROSENJIT BAGCHI, Rutgers University, New Jersey, USA — 3D computational modeling and simulation are presented on adhesion, deformation, rolling and detachment of a liquid capsule on adhesive surfaces in shear flow with an objective to understand the adhesive rolling motion of biological cells, such as leukocyte and cancel cells, and the coupling between cell deformation and biophysics of the adhesive bonds. The computational model is based on an immersed boundary method for deformable capsules, and a finite difference-Fourier transform technique for solving the complete Navier-Stokes equations. The flow solver is coupled with a Monte Carlo simulation representing random process for bond formation and breakage between the capsule and the adhesive surface. Becuase of the stochastic process of bond formation and breakage, the roling motion is comprised of intermittent "stops-and-runs" which is well-known for biological cells such as leukocytes, which is reproduced in our simulations. The major objective of this talk is to present phase diagrams for cell adhesion which are obtained in terms of the critical bond strength as a function of cell deformability and biophysical parameters of the adhesion bonds. Through these phase diagrams, we elucidate the role of the hydrodynamic lift force, that exists on an wall- bounded deformable particle in shear flow, in the process of cell capture. Funded by NSF (BES-0603035 and CTS-0625936).

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