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Flow control using ferrofluids FRANCOIS CORNAT, DAVID BECK, IAN JACOBI, HOWARD STONE, Princeton University — A novel flow control technique is proposed which employs a ferrofluidic lubricant infused in a micro-patterned substrate as a "morphing surface" for control of wall-bounded flows. Traditionally, morphing surfaces produce dynamic changes in the curvature and roughness of solid substrates for active control of high Reynolds number flow features such as boundary layer separation and turbulent streaks. We show how these surface modifications can be achieved with a thin liquid layer in the presence of a normal magnetic field. By impregnating a chemically-treated, micro-patterned surface with a fluorinated ferrofluid, the fluid is maintained as a thin super-hydrophobic film and can be redistributed on the substrate by magnetic forces to dynamically reveal or conceal the underlying surface roughness. Moreover, the surface topography of the ferrofluid film itself can be modified to produce an enhanced roughness, beyond the scale of the underlying substrate pattern. Both types of ferrofluidic surface modifications are studied in micro- and macro- scale channels in order to assess the feasibility of flow modification at low to moderate Reynolds numbers.

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