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A mechanism based on fluid compressibility to explain molecular scale slip behavior NEELESH A. PATANKAR, HUA-YI HSU, Department of Mechanical Engineering, Northwestern University — We reproduce molecular scale slip behavior by solving continuum equations for the shear flow of a *compressible* fluid between two walls *in the presence of wall potentials*. A constant slip length is obtained at low shear rates which transitions, at a critical shear rate, to a different constant slip length at high shear rates. This is consistent with molecular dynamic (MD) results. The critical shear rate for transition can be estimated based on scaling arguments. The numerical results motivate a theoretical solution, based on continuum equations, for the slip lengths at high and low shear rates. Prior MD results can be consolidated in the context of this model, and it also elucidates the mechanism of slip. It is seen that at low shear rates the fluid experiences an additional body force due to the wall potential (e.g. Lennard-Jones potential). This slows down the fluid in the first molecular layer. This body force is non-zero only if the fluid is compressible. At high shear rates this body force is negligible and the slip length is determined by a friction coefficient between the wall and fluid molecules.

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