# Drag reduction and boundary slip at silicone oil-water interfaces

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The interaction between liquid flows and solid surfaces has become an important issue for the manipulation of fluids at small scales[1]. The friction resulting from this interaction has a significant impact on fluid transport and energy dissipation which result in high pumping pressures and high shear rates in the fluid. Lubricant-infused surfaces (LIS)[2], in which a lubricant is trapped within the surface micro- or nano-structure, minimize the contact of the flowing liquid with the solid substrate and, therefore, offer a low friction surface which reduces the hydrodynamic drag significantly. This drag reduction is normally explained as an apparent slip of the fluid due to the mobility of the lubricant layer. Theoretical models predict that this apparent slippage increases with the lubricant height $h_o$ and the ratio of the viscosity of the flowing liquid over that of the lubricant $\mu_w/\mu_o$ (see Fig.1)[3]. Here, using highly accurate microfluidic measurements, we perform experimental observations and numerical simulations on a nanostructured wrinkled surface infused with a thin silicone oil film[4]. Our findings suggest that the apparent slip model is not sufficient to describe the large reduction in drag observed on LIS. We propose that the nucleation of gas at the liquid-lubricant interface, facilitated by flow, is an additional mechanism that could explain the large drag reduction observed in LIS.

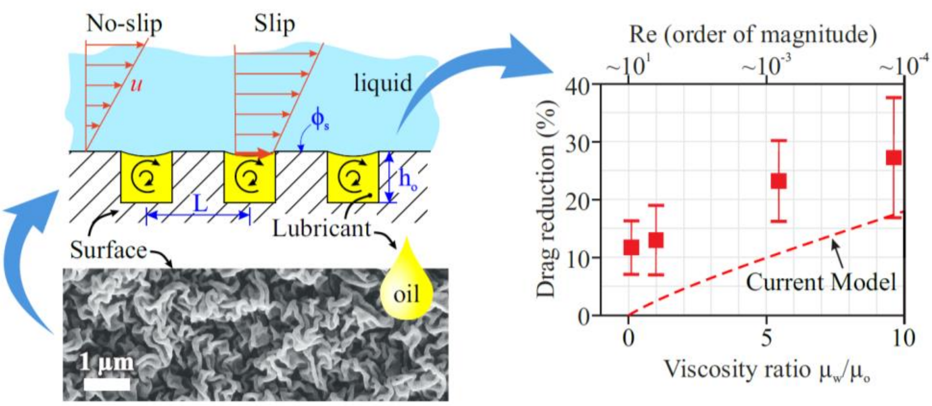


Figure 1: (left) Wrinkled Teflon surfaces are infused with silicone oil, leading to microscale pools of oil between the wrinkles. (right) Discrepancy in the drag reduction estimation between our experiments and the apparent slip model (current model).

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[4] C. S. Ware, T. Smith-Palmer, S. Peppou-Chapman, L. R. Scarratt, E. M. Humphries, D. Balzer, C. Neto. *ACS App. Mater. Interfaces*, 2018, **10**(4), 4173-4182.