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Sustained Turbulent Drag Reduction \mathbf{in} Taylor-Couette Flows Enabled by Low-Temperature Leidenfrost Effect DHANANJAI SARANADHI, DAYONG CHEN, JUSTIN KLEINGARTNER, MIT, SIDDARTH SRINIVASAN, Harvard, ROBERT COHEN, GARETH MCKINLEY, MIT — A submerged body can be heated past its Leidenfrost temperature to form a thick, continuous film of steam between itself and the water. Here we employ a superhydrophobic surface to drastically reduce the energy input required to create and sustain such a boiling film, and use the resulting slip boundary condition to achieve skin friction drag reduction on the inner rotor of a bespoke Taylor-Couette apparatus. We find that skin friction can be reduced by over 90% relative to an unheated superhydrophobic surface at Re=19,200, and derive a boundary layer and slip theory to fit the data to a model that calculates a slip length of 3.12 ± 0.4 mm. This indicates that the boiling film has a thickness of 112 μ m, which is consistent with literature.

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