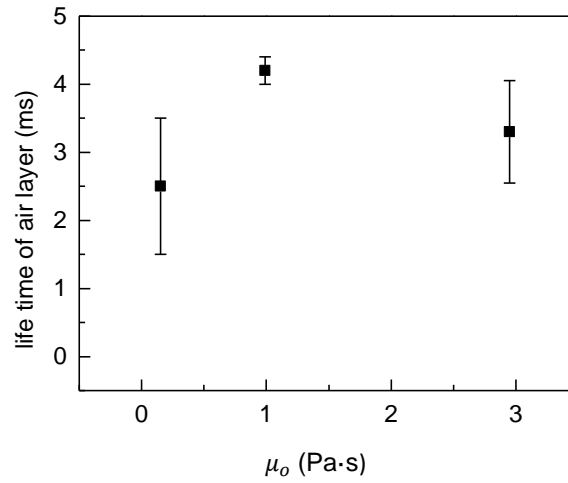
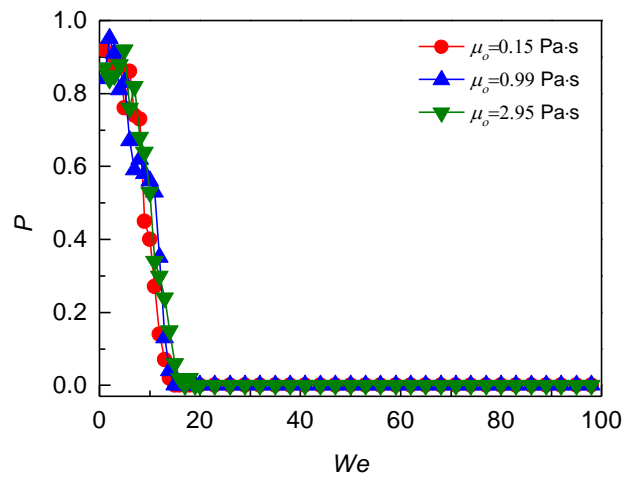


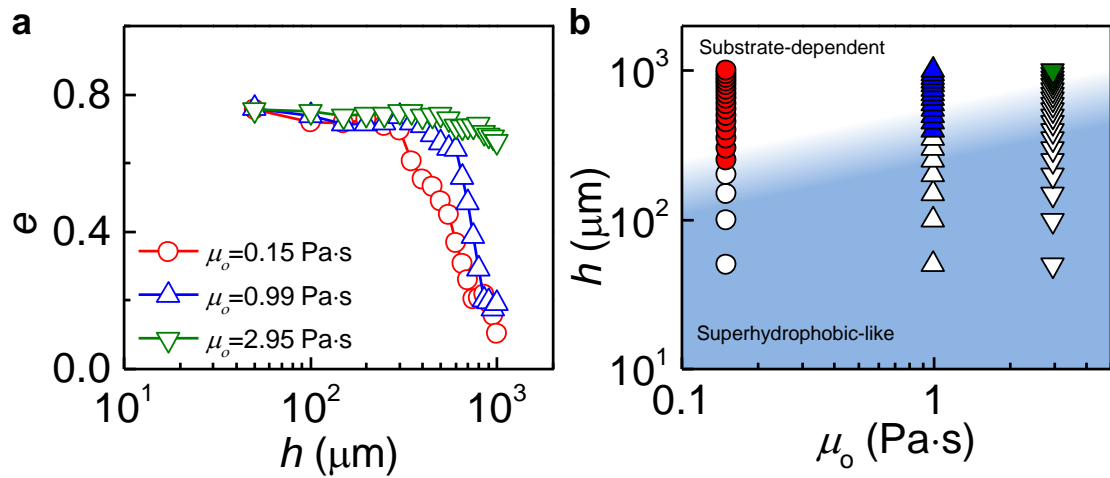
Supplementary Figures



Supplementary Figure 1 | The variation of the life time of thin air layer on liquid substrates of different viscosity. The thickness of the liquid substrate is $h=50 \mu\text{m}$ and the Weber number is $We = 20$.



Supplementary Figure 2 | The probability (P) of sustaining an intact thin air cushion on pure oil bath under different We . For $We \lesssim 10$, the percentage of achieving complete rebound with an integral air layer entrapment is 75% ~ 90%, whereas it drops sharply to nearly zero for $We \gtrsim 18$. Moreover, the oil viscosity has no apparent effect on the probability of sustaining an intact thin air cushion.



Supplementary Figure 3 | (a) The variation of the restitution coefficient e as a function of oil thickness h for oil films with viscosity of 0.15 Pa·s, 0.99 Pa·s and 2.95 Pa·s, respectively. The We is 2.0. (b) The dependence of superhydrophobic-like bouncing (open symbols) and substrate-dependent bouncing (solid symbols) on h and μ_o . In the superhydrophobic-like bouncing regime, the effect of liquid substrate on the bouncing is negligible whereas e is greatly affected by the oil film in the substrate-dependent regime.