Supplementary Information

Influence of Liquid Repellency and Slipperiness on Blood-Material Interactions

Halle J. Cantor#, Adil Rather#, Ragavi Rajasekaran, Adrian Aligwekwe, Ashley C. Brown, Arun Kumar Kota**

Halle J. Cantor, Adrian Aligwekwe, Ashley C. Brown

Lampe Joint Department of Biomedical Engineering, North Carolina State University and University of North Carolina at Chapel Hill, Raleigh, NC 27695, USA

Comparative Medicine Institute, North Carolina State University, Raleigh, NC 27606, USA

Email: aecarso2@ncsu.edu

Adil Rather, Ragavi Rajasekaran, Arun Kumar Kota

Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh 27606, USA

Email: akota2@ncsu.edu

Section S1: Estimation of solid surface energy

We used Owens-Wendt approach to estimate the solid surface energy of all four surfaces. The Owens-Wendt equation used to estimate the solid surface energy is:

$$\gamma_{lv}(1+\cos\theta) = 2(\sqrt{\gamma_{sv}^{d}\gamma_{lv}^{d}} + \sqrt{\gamma_{sv}^{p}\gamma_{lv}^{p}}) \quad \text{(S1)}$$

Here, γ_{lv} is liquid surface tension, γ_{sv}^{d} and γ_{lv}^{d} are the dispersive components of solid and liquid, γ_{sv}^{p} and γ_{lv}^{p} are the polar components of solid and liquid, θ is the contact angle of the test liquid. We used hexadecane (with dispersive component of γ_{lv}^{d}= 27.5 mN/m and polar component of γ_{lv}^{p}= 0) as the non-polar test liquid to estimate the dispersive component of the solid surface energy γ_{sv}^{d}, and water (with dispersive component of γ_{lv}^{d}= 21.1 mN/m and polar component of γ_{lv}^{p}= 51.0 mN/m) as the polar test liquid to estimate the polar component of the solid surface energy γ_{sv}^{p}. The advancing contact angles of hexadecane and water on our less slippery hydrophobic surfaces were 56° and 110°, on our more slippery hydrophobic surfaces were 28° and 100°, on our less slippery hydrophilic surfaces were 26° and 65°, and on our more slippery hydrophilic surfaces were 11° and 33°, respectively. Based on these values, we estimated the solid surface energy of all four surfaces.

Section S2: Contact angle hysteresis measurement

We characterized the wettability of our four distinct surfaces by measuring the advancing contact angles θ_{adv} and receding contact angles θ_{rec}, by increasing and decreasing, respectively, the volume of a droplet on the surface using a micrometer syringe (Gilmont). Our results (Figure S2) indicate that less slippery hydrophobic and less slippery hydrophilic surfaces display high contact angle hysteresis, and more slippery hydrophobic and more slippery hydrophilic surfaces display low contact angle hysteresis.

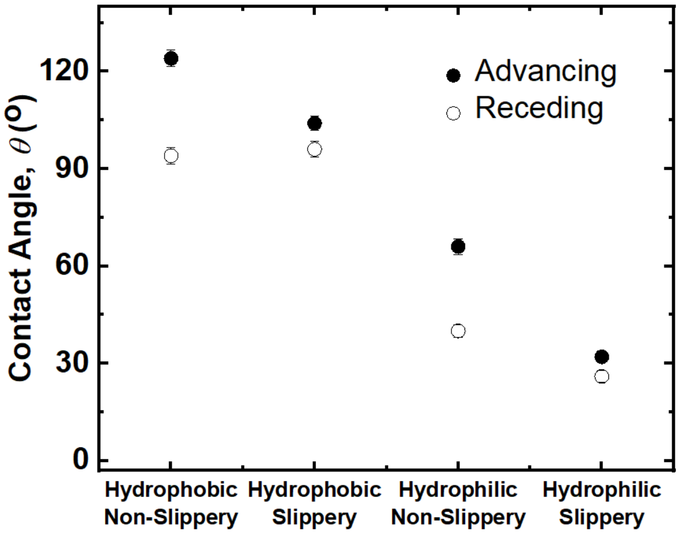

Figure S2. Contact angles of different slippery surfaces.

Section S3: Estimation of sliding angles

We estimated sliding angles ω on all four surfaces based on a balance between work done by gravitational force and work expended due to adhesion.

$$\sin \omega \approx \frac{\gamma_{lv} D_{TCL} (\cos \theta^{*}_{rec} - \cos \theta^{*}_{adv})}{\rho g V} \qquad \text{(S2)}$$

Here, γ_{lv}, ρ and V are surface tension, density, and volume of the liquid droplet, respectively, g is the acceleration due to gravity, θ^{*}_{adv} and $\theta^{*}_{hier,rec}$ are the advancing and receding contact angles, respectively, and D_{TCL} is the width of triple phase contact line perpendicular to the droplet sliding direction. Assuming the droplet is a spherical cap, width of the triple phase contact line can be calculated as $D_{TCL} = 2 \sin \bar{\theta} \left[\frac{3V}{\pi(2-3\cos\bar{\theta}-\cos^3\bar{\theta})}\right]^{1/3}$. Here, $\bar{\theta}$ is the average contact angle given as $\cos \bar{\theta} = (\cos \theta^{*}_{hier,adv} + \cos \theta^{*}_{hier,rec})/2$. The experimentally measured sliding angles on all four surfaces align reasonably well with the theoretical estimations (Table S1) for 20 µL droplets of water (γ_{lv} = 72.1 mN/m, ρ = 997 kg/m^3).

Table S1. Measured and estimated sliding angles.

Surfaces	Measured sliding angle	Estimated sliding angle
Less slippery hydrophobic	35°	34°
More slippery hydrophobic	8°	7°
Less slippery hydrophilic	32°	33°
More slippery hydrophilic	7°	6°