Supplementary Information

Dynamic Droplet Behavior for Analyte Localization on Phase Change Liquid Infused Surfaces

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The Supplementary Information (in this document) includes:

Table S1: Temperature of the heater during static water contact angle, sliding angle, and contact angle hysteresis experiments corresponding to each oil's solid, liquid, and mush phases

Oil	Phase	Temperature (°C)
Silicone Oil	Solid	20
	Mush	60
	Liquid	75
Coconut Oil	Solid	20
	Mush	26
	Liquid	40
Beeswax	Solid	25
	Mush	53
	Liquid	75
Paraffin Wax	Solid	25
	Mush	59
	Liquid	75

Text S1: Description of PC-LIS preparation using excess oil fabrication methods

Once oils were added to the textured substrates using the methods described in the PC-LIS Preparation section of the main text, samples were transferred to the vacuum drying oven. The oven was set to a temperature 10°C above the melting point of the oil and brought to a full vacuum. Samples were left inside of the vacuum oven for 60 minutes. The pressure inside of the oven was then released and the sample was vertically annealed on one side for 10 minutes. After annealing, the sample was blotted to remove excess oil, and the final mass of the sample was recorded to determine oil loss during infusion. This fabrication method had fewer annealing steps than the method described in the main text, and therefore resulted in more excess oil cloaking the underlying nanograss features. The main text method resulted in the morphologies shown in Figure S1, while the excess oil method resulted in the morphologies shown in Figure S2. All results and data shown in the main text used the optimized preparation method that removed excess oil.

Table S2. Temperature and humidity of the surrounding environment for all evaporation experiments

PC-LIS Oil	Fabrication Method	Temperature (°C)	Humidity (%)
Silicone Oil	Thin-Layer	20	44
		75	44
	Thick-Layer	20	52
		75	52
Coconut Oil	Thin-Layer	20	53
		75	58
	Thick-Layer	20	54
		75	58
Beeswax	Thin-Layer	25	53
		75	44
	Thick-Layer	25	49
		75	45
Paraffin Wax	Thin-Layer	25	58
		75	58
	Thick-Layer	25	58
		75	58

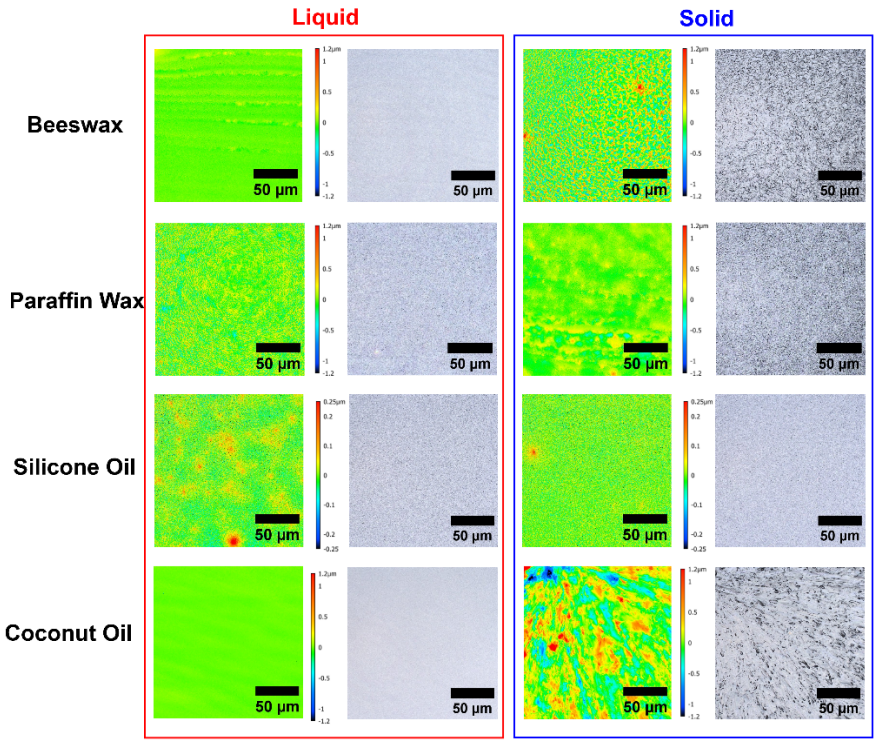


Figure S1. Profilometer images of optimized oils in liquid and solid state

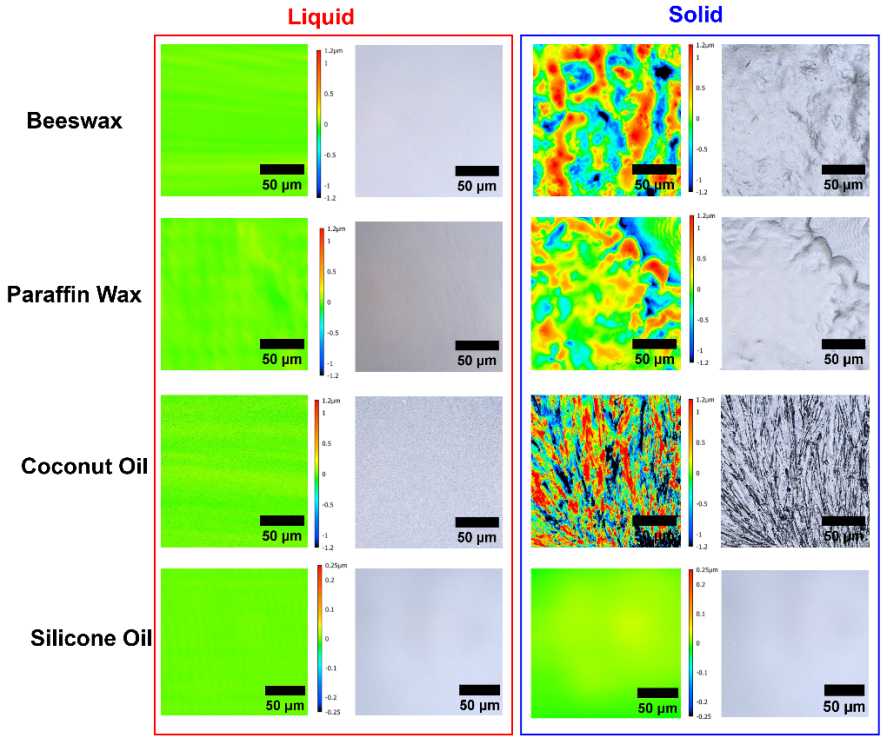


Figure S2. Profilometer images of excess infused oils

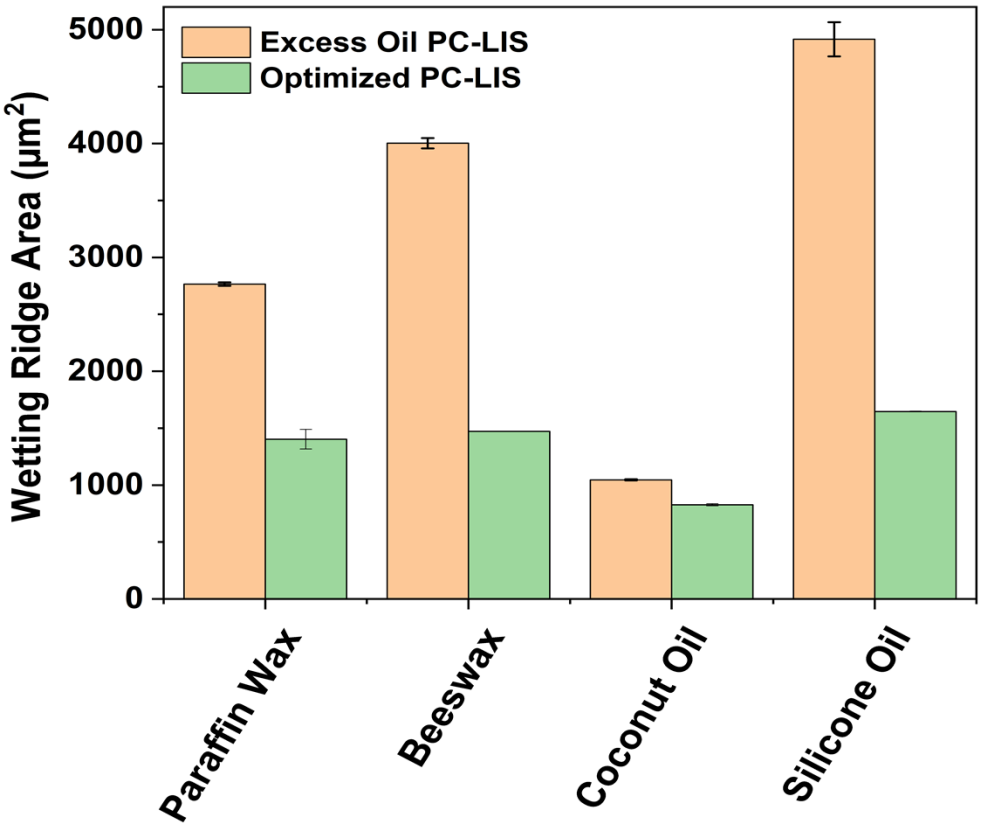
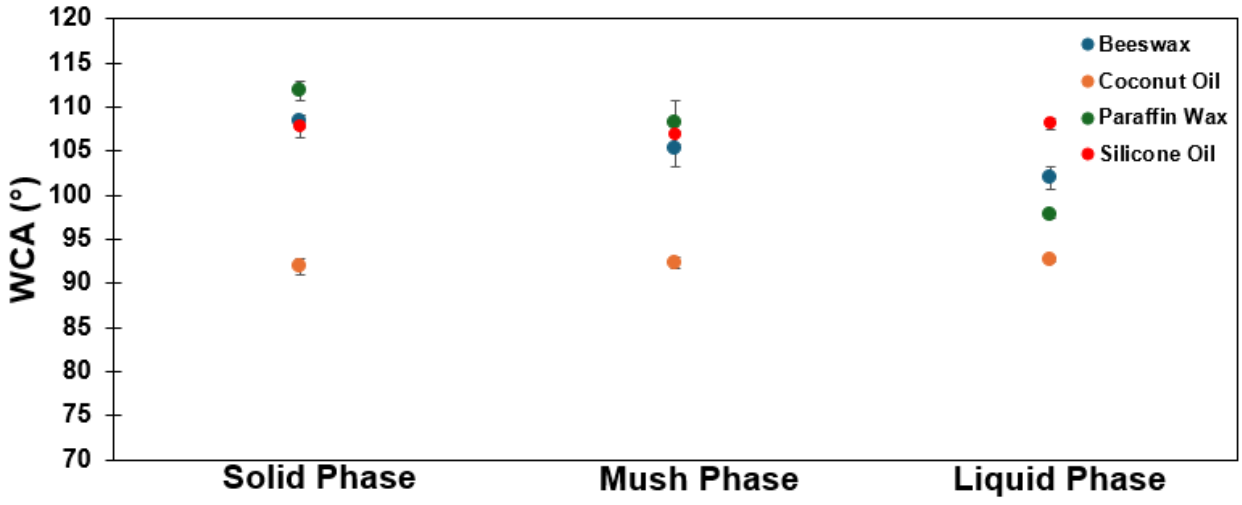


Figure S3. Wetting ridge area measurements



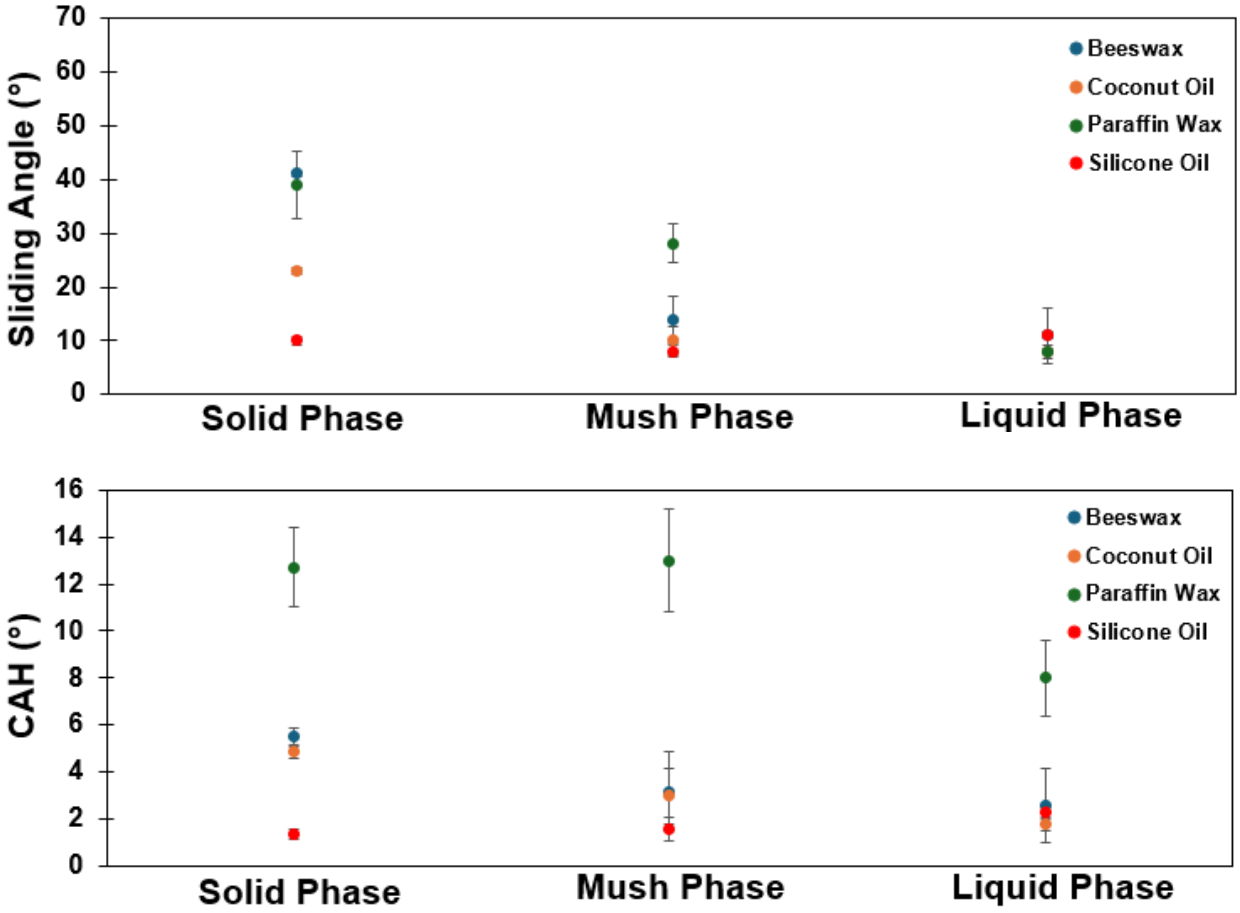


Figure S4. Contact angle, sliding angle, and contact angle hysteresis of all 4 oils in solid, mush, and liquid states

Text S2: Uncertainty Analysis

The uncertainty in the measured water contact angle was determined by propagating the independent fitting and calibration errors reported by the goniometer software. The fitting error ($\delta\theta_{fit}$) was obtained directly from the contact angle fit (3°), and the calibration error ($\delta\theta_{cal}$) was taken as 1° based on instrument alignment specifications. These were combined and propagation of uncertainty was calculated.

$$\delta\theta = \sqrt{(\delta\theta_{fit})^2 + (\delta\theta_{cal})^2} = 3.2°$$

Base radius was calculated from the goniometer's calibrated image scale. The dominant source of radius error was the measurement uncertainty of the fitted radius. This value was used as a constant propagated measurement uncertainty across all radius time data points, which was determined to be:

$$\delta R = 0.025mm$$

Table S3. Deposition Area of PC-LIS, LIS, and substrate controls

Sample	Average Area Localization (μL^2)
Silicone Oil	$1.1 \times 1.4 \times 10^4\ 10^4$
Coconut Oil	3.9×10^4
Paraffin Wax	1.4×10^5
Beeswax	1.3×10^5
Flat Fluorosilane	1.1×10^7
Untreated Nanograss	4.7×10^7

Table S4. Signal to noise and detection limit of fluorescence imaging on PC-LIS

Concentration	Intensity	SNR	LOD
0.01	233259 (± 3975)	55	0.000003
0.001	21059 (± 350)	53	
0.0001	11173 (± 208)	47	
0.00001	1697 (± 72)	22	
0.000001	168 (±20)	0	

$$LOD = \frac{3\sigma}{b}$$

Limit of detection (LOD) was calculated based on the standard deviation of the background (σ) and the calibration slope from the concentration vs intensity data (*b*).

$$SNR\,\frac{S-\mu}{\sigma}$$

The Signal-to-noise (SNR) ratio was calculated using the mean signal intensity (*S*), the background mean (μ), and the background standard deviation (σ). [1]

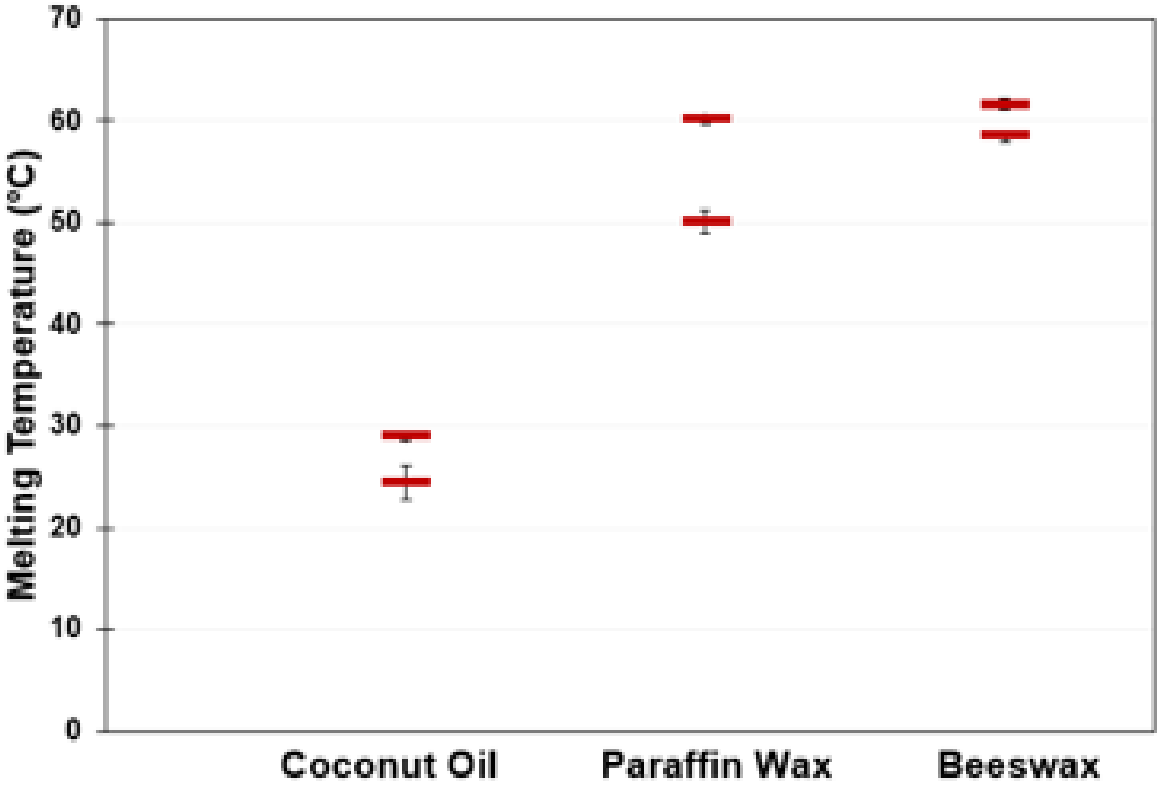


Figure S5. Melting temperature range of the phase change oils

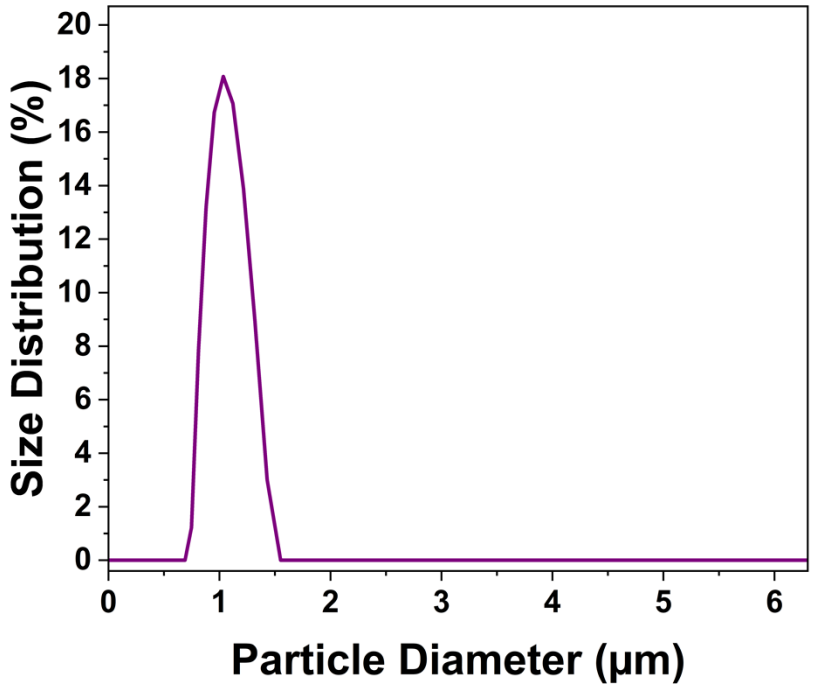


Figure 6. Particle size distribution of the model microplastics used.

Particle per droplet were calculated based on the hard-sphere volume fraction.

$$\emptyset = \frac{4}{3}\pi a^3 \frac{N}{V} = 4\ x\ 10^5$$

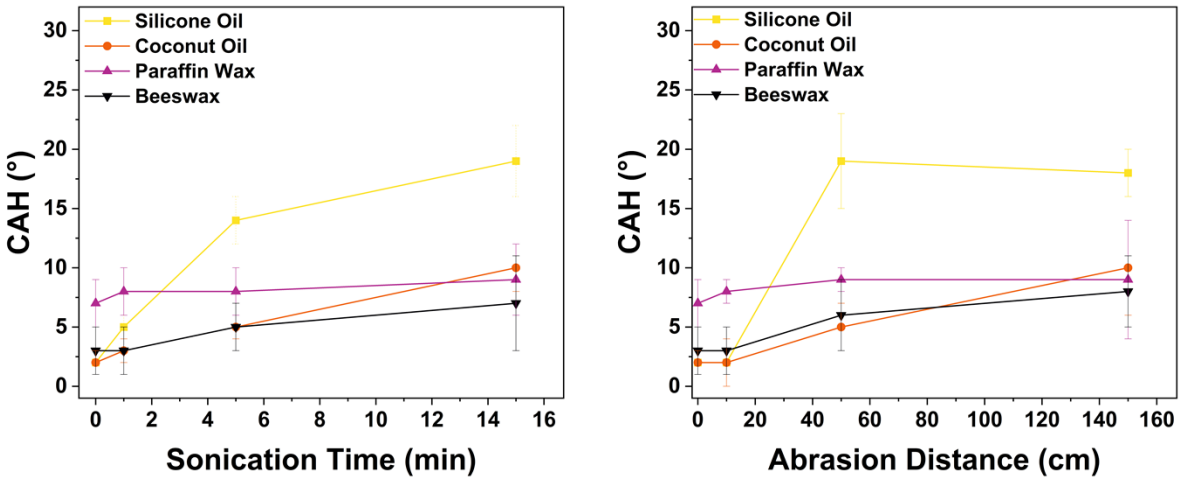


Figure S7. CAH changes from durability tests.

References

[1] "International Union of Pure and Applied Chemistry," Report. 2001.