Electronic Supplementary Material (ESI) for Materials Horizons.

Supporting Information

Liquid Metal Droplets with High Elasticity, Mobility and Mechanical Robustness

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Experimental Section:

1. Preparation of the liquid metal droplets

The gallium-indium-tin alloy (Wochang, China) was extruded from the syringe to form a liquid metal droplet with a diameter of 2 mm. To treat the formed liquid metal droplet with aqueous sodium hydroxide (NaOH) solution,we immerse them into the 20 wt. % NaOH (AR, 96%, Macklin, China) solution for around 3 seconds and then collect them up for the subsequent usuage. To form the liquid metal marbles, we dropped the pure liquid metal droplets or NaOH-treated liquid metal droplets on a powder layer of 35 μm PTFE Powder (Sigma-Aldrich, USA) or 2 μm silica particles (Tospearl 2000B*, TANAC INNOVATION COMPANY, made in Japan) and rolled them for around 10 seconds to sufficiently coat the surface with PTFE powder. To form water marbles, we coated a water droplet made of deionized water with 2 μm silica particles.

2. Bouncing of the liquid metal droplets

We released the different types of liquid metal droplets at the same initial height h_0≈15 mm. After free falling, the droplet impacted the PMMA substrate (Foshan

Maoyu Plastic Materials Company, China) and the corresponding bouncing behaviors were monitored using a upon high-speed camera (MIRO LAB 110, VISION RESEARCH PHANTOM, USA) at a frame rate of 1600 fs^{-1}. The bouncing times n as well as the rebound height h_n during each bouncing were characterized by analyzing the high-speed images.

3. Fatal jump of the liquid metal droplets

The liquid metal droplets were dropped from a gradually increased height to the PMMA substrate. When the height increased to a critical value h_c, the rupture of the liquid metal droplets occured. We characterized the mechanical robustness of the liquid metal droplet, which represents the capability to resist shock, by calculating the critical pressure $p_c = \rho g h_c$, with ρ being the density, g being the gravitational acceleration.

4. Rolling of the liquid metal droplets in an inclined substrate

We placed a liquid marble on inclined substrate with an adjustable tilt angle (Optical Contact Angle Measuring Instrument, SINDIN, China).When the tilt angle was gradually to a critical value θ_c, the liquid marble starts to scroll. The mobility of the liquid droplets was tested by placing the liquid droplets on an inclined substrate with an angle of 14° or 28°. The velocity profiles of liquid droplets were analyzed using the high-speed images.

5. High Speed imaging of the movement of the as-made liquid metal droplets.

Movie S1: the bouncing of a PTFE-coated, NaOH-treated liquid metal droplet.

Movie S2: the bouncing of a PTFE-coated liquid metal droplet.

Movie S3: the bouncing of a NaOH-treated liquid metal droplet

Movie S4: the bouncing of a pure liquid metal droplet

Movie S5: the bouncing of a PTFE-coated water droplet

Movie S6: three different regimes of the liquid metal droplets upon impacting on the substrate.

Movie S7: the collision, merging and bouncing together of two PTFE-coated, NaOH-treated liquid metal droplets

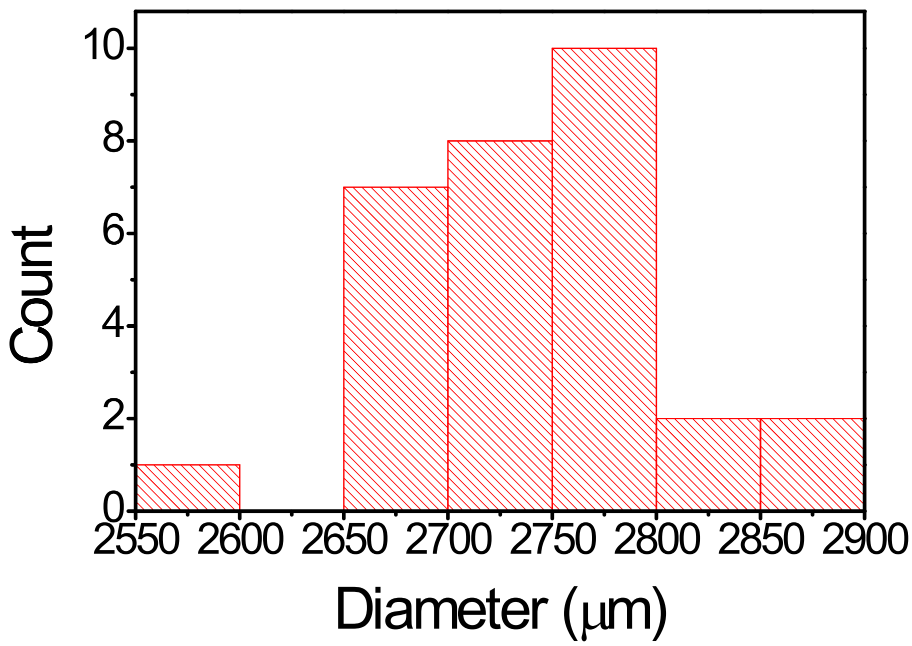

Figure S1. The size distribution of thirty as-made PTFE-coated, NaOH-treated liquid metal droplets.

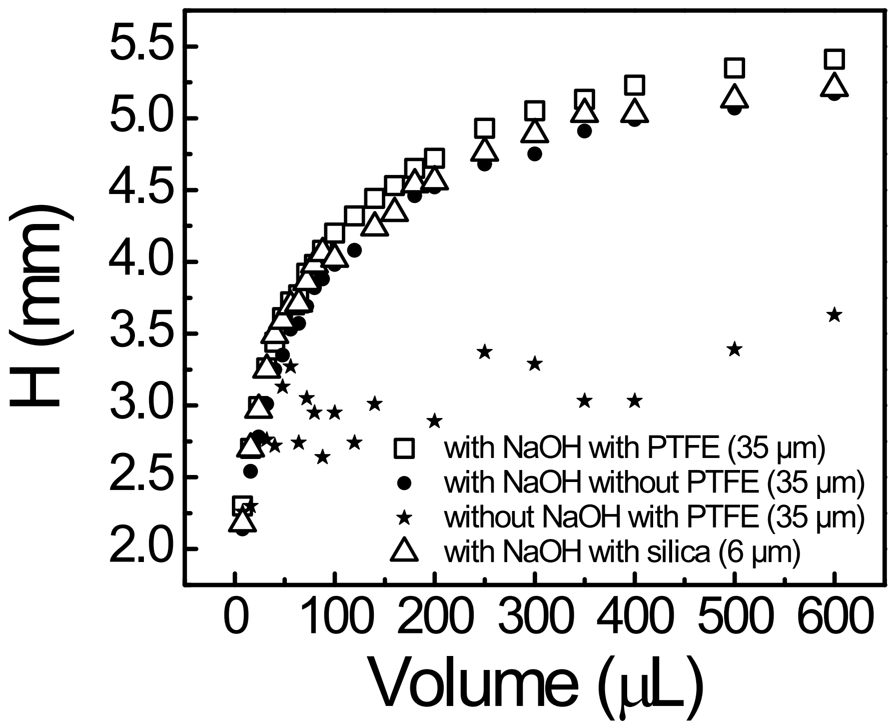

Figure S2. Height of liquid metal droplets vs. volume.

Table S1: The critical scroll angle of different kind of liquid metal droplets on Al and Cu substrates.

liquid metal droplets	scroll angle (Al)	scroll angle (Cu)
with NaOH with 35 μm PTFE	4.5°±0.8°	2.3°±0.4°
without NaOH with 35 μm PTFE	5.7°±0.9°	6.0°±0.8°
with NaOH without PTFE	stick	stick
without NaOH without PTFE	stick	stick
with NaOH with 6 μm silica	stick	stick

Table S2: Measured surface tension of the different modified liquid metal marbles by the menthod in the literature. (see Colloids and Surfaces A: Physicochem. Eng. Aspects 351 (2009) 78-82).

Liquid metal marble with	γ (mN/m) via h_{max}
35 μm PTFE and NaOH	472 (4.47 mm)
NaOH	422 (5.17 mm)
35 μm PTFE w/o NaOH	182 (3.39 mm)
6 μm silica and NaOH	428 (5.21 mm)