Supplementary material

Non-wettable/wettable coatings floating on liquid metal marbles for anti-combination, reversible conductivity transformation and magnetic motion in solution

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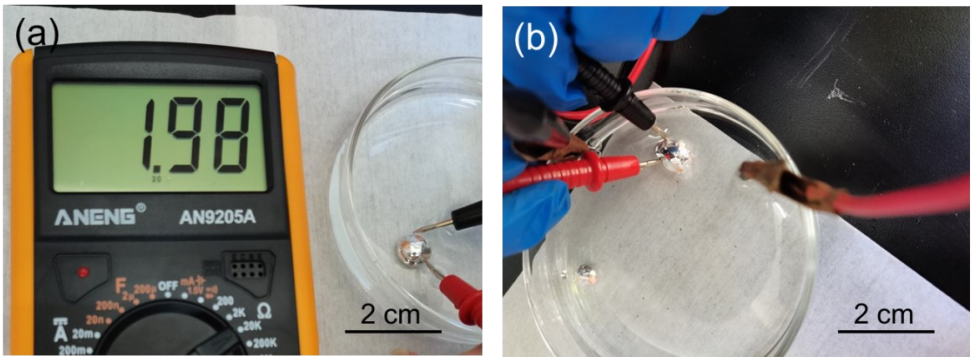

Figure. S1 (a) Resistance test of individual LMs marble coated by polyethylene/Cu coatings; (b) Resistance test of individual LMs marble after the opening of polyethylene/Cu coatings by a 4V electric field.

Apparently, whether under the action of an electric field or a magnetic field, the coatings will be opened. At this time, if the LMs gather together, they will be immediately combined with each other. So the conductivity transition we refer to in our work is for individual LMs marble coated by polyethylene/Cu coatings. And the conductivity transition tests have been presented in Figure. S1. It can be clearly observed that the resistance of individual LMs marble is nearly 2000 Ω, which is the resistance of HCl solution. After the opening of polyethylene/Cu coatings, the circuit is directly conductive.

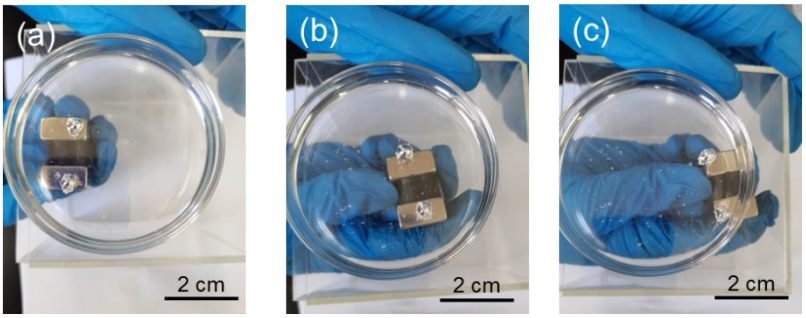

Figure. S2 (a) to (c) Magnetic motion of LMs pair coated by P-Ni/Cu coatings”

Magnetic motion of LMs marble pair coated by P-Ni/Cu coatings has been presented in “Figure. S1. Apparently, the two LMs marbles are attracted to move by magnetic field without combination. For polyethylene/Cu coatings, LMs marbles will probabilistic combined with each other due to the open of polyethylene/Cu coatings by electric field during their moving. Therefore, short-range action multi-electrodes such as in Ref “Ren, Hongtai, et al. "Light-controlled versatile manipulation of liquid metal droplets: a gateway to future liquid robots." Materials Horizons 8.11 (2021): 3063-3071.” should be needed for the multi- marbles motions by electric fields.

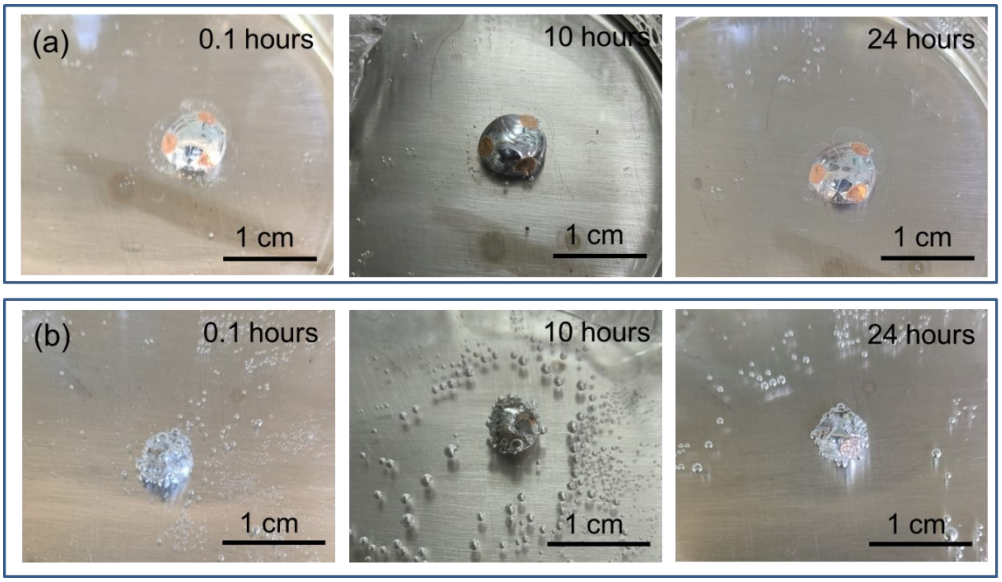

Figure. S3 (a), (b) Life test of the polyethylene/Cu (0.7cm/0.3cm) and P-Ni /Cu coatings (0.3cm/0.3cm) in HCl solution under 45℃

No shedding of polyethylene/Cu and P-Ni /Cu coatings on LMs has been found in our experiments even after 24 hours, as shown in Figure. S3(a) and 3(b). For P-Ni/Cu coatings, significant corrosion of nickel by acid can be easily observed after 10 hours. After 24 hours, the outer p-Ni coatings have been corroded by acid, leaving a Cu/glue layer adhered to the surface of LMs. Note that the middle images in Figure. S3(a) and 3(b) were shot at night under light illumination, the others were shot under nature. As a result, these images show a little difference.