Research Activities Report - 2022 Overseas Research Experience Program -

みらいを つくる つたえる まもる。
大阪工業大学
OSAKA INSTITUTE OF TECHNOLOGY

Research Topic	Fabrication of polyhedral liquid marble via electrostatic method	Graduate school of Engineering
Host University	The University of Newcastle / New South Wales / Australia	Applied Chemistry
Duration	From July 17 to October 20, 2022	TAKEUCHI Kazusa

Summary of the Research Activities

Liquid marbles (LMs) are small droplet encapsulated by hydrophobic particles. LMs are generally prepared by rolling liquid droplets over a hydrophobic particle bed. The most of reported stabilizer are spherical or undefined, and the most of LMs are spherical or ellipsoidal. Recently, it has been reported that the polyhedral LMs can be prepared by using hydrophobic hexagonal poly(ethylene terephthalate) (PET) plate as a stabilizer. Polyhedral LMs were also prepared using a rolling method. Recently, an electrostatic formation method has been researched as a method of preparing LMs different from a rolling method (Fig. 1). This is a method of preparing LMs by transporting particles across an air gap to a pendent droplet in the presence of an electric field.

In this study, we attempted to fabricate LMs stabilized with 6, 12 and 38 µm thickness square or circle, hexagonal PET-PPy-C_8F plates using an electrostatic formation method. When the plate bed was moved closer to the droplet under an applied voltage, the plate started to jump from the bed to the droplet surface at a specific distance for all plate thicknesses investigated in this research (Fig. 2). Thinner plates were found to jump from the particle bed to the droplet at greater distances than thicker plates(Fig. 3). This was in striking contrast to the behavior of spherical particles, which become more cohesive as the particle size and thus mass decreases; for plates, the thickness affects the mass much more strongly than the surface area and thus interparticle cohesion (plate weight; 6 µm<12 µm<38 µm). Some experiments were also performed with hexagonal and circular plates of comparable thickness and dimensions to the thicket square plates. Circular plates tended to jump to the droplet at greater distances than squares, which jumped at greater distances than hexes, an order corresponding directly to their masses – there was no clear evidence that their shape influenced their propensity to jump (plate weight; circle<hexagon<square).

I will submit a paper about this study soon!

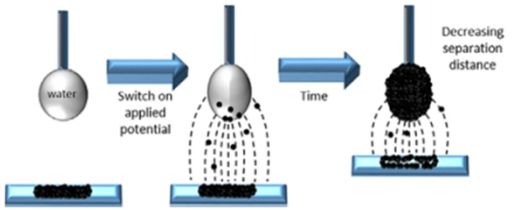

Figure. 1 Fabrication of LM by electrostatic driven process

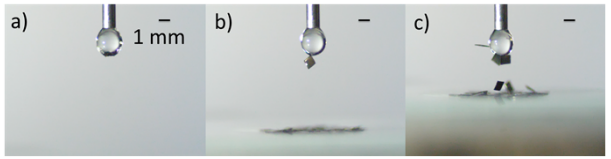

Figure. 2 Images of the electrostatic transfer of the first plate to the pendent droplet at an applied potential of 2.0 kV for square-shaped PET-PPy plates of a) 6 µm, b) 12 µm and c) 38 µm.

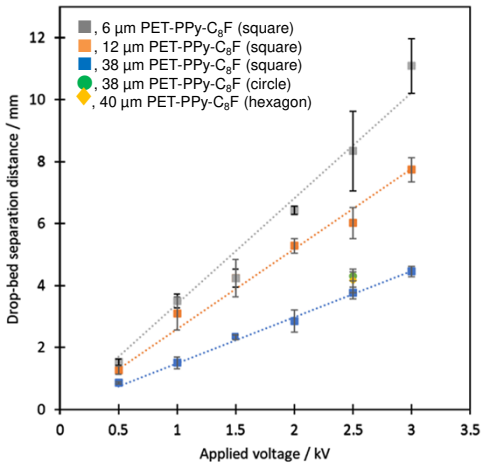

Figure. 3 Droplet-bed separation distance at which the first PET-PPy plates were extracted from the plate bed for each studied applied potential as the plate bed approaches the pendent water drop at a rate of 0.25 mm s^{-1}.

College Life, Friends and Others

I stayed The University of Newcastle in Australia for about three months. The University of Newcastle is in forest and the scenery inside the university is very beautiful. I loved walking through the beautiful campus to go to the lab. The lab members were very kind and my life in Australia was very enjoyable. I went to an Italian restaurant on weekend with a dormitory student. We ate delicious pizza at the restaurant and drank beer. It was very fun. There are many other good memories. I had precious experiments which I cannot have in Japan.

指導教員講評

ニューカッスル大学への短期留学を通じて何事にも自ら率先して行う能力が身についたと感じられます。今回の留学で得られたことを活かし、今後の発展を期待します。
指導教員氏名: 藤井秀司