VIDEO ARTICLE

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Liquid Plasticines: Self-Supporting and Shapable Liquid Containers

Li Xiaoguang[1,*], Shi Haixiao[1], Wang Yiqi[1], Wang Renxian[1], Niu Jicheng[2], Li Fei[2]

[1]School of Physical Science and Technology, Northwestern Polytechnical University, Xi'an, 710129, China
[2]School of Life Science and Technology, Xi'an Jiaotong University, Xi'an, 710049, China

*Corresponding author: E-mail: lixiaoguang@nwpu.edu.cn

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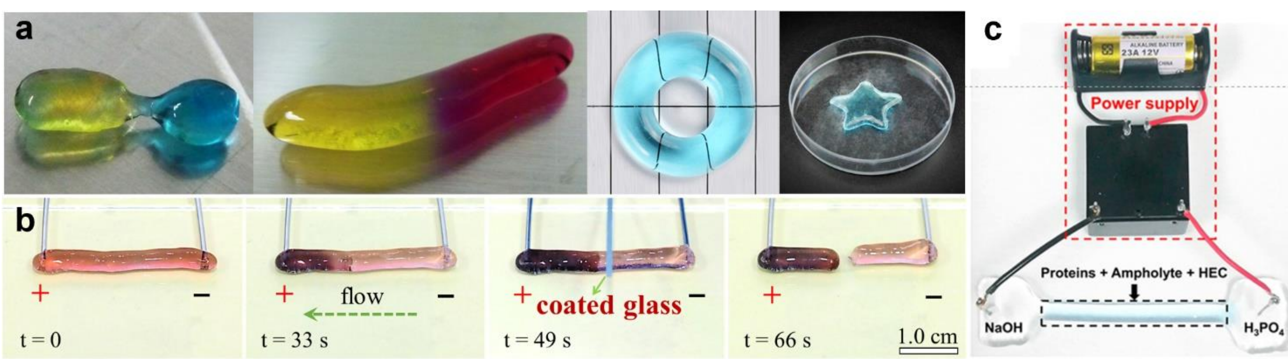
Graphical Abstract



Abstract

This lecture reports a self-supporting liquid container with solid-like plasticity, named liquid plasticine (LP), which is achieved by coating a liquid entity (droplet/pancake) with hydrophobic particles and subjecting the interfacial particles to jamming. When particles jam at the liquid-air interface, the surface becomes a solid layer with rigidity, which accounts for the plasticity of the particle-coated liquid entity. LPs with various shapes can be produced using hydrophobic tools via either top-to-bottom or bottom-to-top routes. Considering the particle shell is very thin (~20 nm), LPs can be reckoned as self-supporting liquid containers. There are several characters that distinguish LPs from common solid containers. They can be readily cut or joined without liquid flowing away. The inner stuff can be extracted by easy insertion of a pipettor into a LP. The particle shell is not dense for which gas is easy to come into or out of a LP. In addition, compared with a common droplet, a LP with a complex shape features very large specific surface area, which brings about high efficiency when gas is involved in a given application. We have shown that when a cylindrical LP is used as a gas sensor, it not only detects the existence of target gas but also reveals the gas diffusion speed and frontier concentration, which is superior to common spherical droplet sensors. We have also applied liquid plasticines in protein analysis. In this application, an oar-shaped LP is produced to realize separation of different kinds of proteins with the aid of isoelectric focusing technique. The separated proteins can be *in-situ* analyzed and easily extracted for further analysis. The LPs are also capable of serving as bioreactor for cell culture, and the non-wetting state assures the 3D growth of embryonic stem cells.

The channel structure, designable shape, and other intrinsic properties endow LPs with great application potential as novel containers in chemistry, material, and biomedicine areas.

Keywords: Non-wetting; liquid plasticines; liquid marbles; microreactors.

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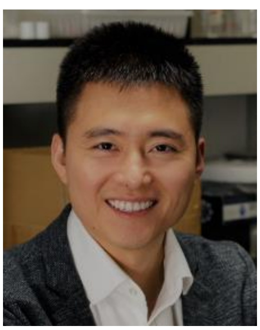
Biography of Presenting Author



Li Xiaoguang, Associate Professor, received his bachelor degree of Applied Physics in 2008 and PhD degree of Condensed Matter Physics in 2013, both in Tongji University, China. From 2010 to 2012, he underwent joint PhD training in CSIRO-Material Science and Engineering, Australia. From 2013 to 2015 he did postdoctoral research in Tongji University and Peking University. Since joining Northwestern Polytechnical University in 2015, his research has focused on the wetting area particularly on particle-coated liquid entities. His key achievements lie in the establishment of the methods for liquid shaping in air environment, with the shaped liquids termed as liquid plasticines. He has also designed novel microreactors based on spherical liquid marbles and variously shaped liquid plasticines, for gas sensing, cell culture, protein analysis, etc. In addition, he has contributed much to the fundamental issues regarding liquid marbles and liquid plasticines; in particular, he has clarified the physical connotation and measurement principle of the liquid marble's effective surface tension, which had confused researchers for many years. He has published 50 papers, and several of his works are selected as the Covers of the journals, and some reported by famous media including Discovery Channel, New Scientist, and Advances in Engineering.

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