A simple method to print planar microstructures of polysiloxane

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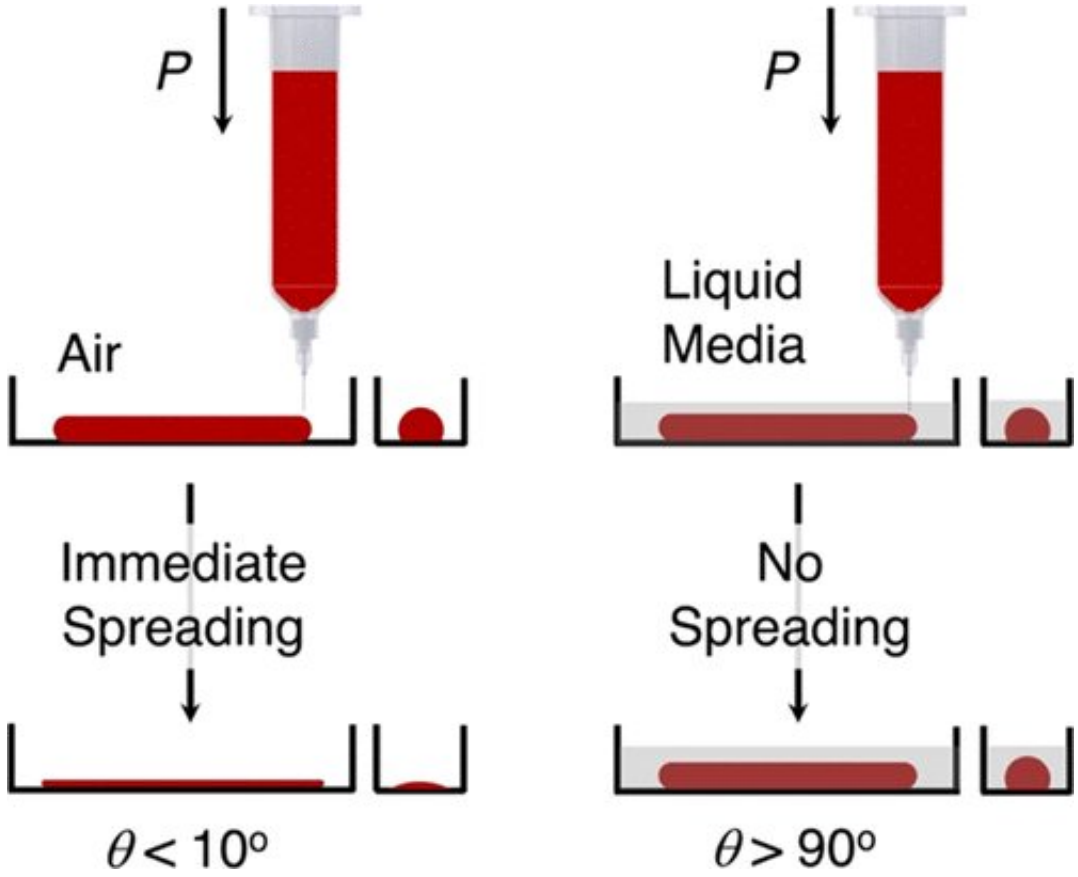

Credit: Singapore University of Technology and Design

Polysiloxane is an elastic polymer which is widely used in fluidics, optics, and biomedical engineering. It offers desirable properties for microfabrication due to its castable and curable properties.

To produce small scale structures consisting of polysiloxane, soft lithography is used as a standard technique in academic research laboratories.

Recent advances in digital fabrication, in particular 3-D printing, have enabled direct patterning of polysiloxane albeit with strict requirements for the properties of the printing inks. Suitable inks are usually highly viscous and fast-curing. For 3-D printing, the yield stress or photocurable characteristics of the polysiloxane resins are required to allow them to retain the printed shape.

The low viscosity of the additive-curing polysiloxane makes them incompatible for printing with direct ink writing (DIW) 3-D printers. While the low viscosity of the polysiloxane resin such as Sylgard 184 facilitates easy extrusion through the nozzles, the reflow of the patterned resin can compromise the print fidelity.

Researchers from Singapore University of Technology and Design's (SUTD) Soft Fluidics Lab developed a simple method to fabricate reproducible planar microstructures consisting of polysiloxane using commercially available liquid polysiloxane resins without changing their properties.

In this newly developed approach, curable liquid polysiloxane with the viscosity in the range of 1-100 Pa.s was dispensed in a liquid immiscible with the resins such as methanol, ethanol, and isopropanol. The contact angle of the dispensed polysiloxane on the substrate increased from 20o in the air to 100o in alcohols. The increase in the contact angles allowed maintaining the structures of patterned polysiloxane until curing, after which the embedding liquid was readily removed by evaporation. The method was termed as embedded ink writing (EIW).

"With EIW, polysiloxane inks can be patterned on different soft and

rigid substrates without compromising the adhesion of the printed polysiloxane with the substrate," explained lead author Dr. Rahul Karyappa from SUTD.

"The presence of embedding media did not hamper the bonding of the polysiloxane filaments in both lateral and vertical arrangements, allowing this technology to be effective especially in fabricating flexible devices and microfluidic devices using commercially available PDMS resin," added principal investigator, Assistant Professor Michinao Hashimoto from SUTD.

More information: Rahul Karyappa et al, Embedded Ink Writing (EIW) of Polysiloxane Inks, *ACS Applied Materials & Interfaces* (2020). DOI: 10.1021/acsami.0c03011

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