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Preventing Oxide Adhesion of Liquid Metal Alloys to Enable Actuation in Microfluidic Systems ISHAN JOSHIPURA, ALEXANDER JOHNSON, HUDSON AYERS, MICHAEL DICKEY, North Carolina State University —
This work explores the wetting behavior of an oxide-coated liquid metal, eutectic alloy of gallium and indium ('EGaIn'), which remains a liquid at room temperature. Liquid metals uniquely combine fluidity with metallic properties. Combined, these properties enable soft, stretchable, and shape reconfigurable electronics with 'softer than skin' interfaces. Ga forms spontaneously a thin surface oxide that alters its wetting behavior and makes it difficult to move across surfaces without leaving residue behind. We examine the effects of surface roughness (i.e., Cassie-Baxter state) and lubrication to minimize adhesion of Ga oxide to surfaces. Lubricated surfaces create a 'slip-layer' of liquid between the metal and surface that also inhibits wetting. This slip layer allows the metal to move reversibly through microchannels by preventing adhesion of the oxide. The metal may be pumped or moved by using low voltages or pneumatic actuation. Optical microscopy confirms the importance of the slip-layer, which enables non-stick motion of the metal through capillaries. Finally, electrochemical impedance spectroscopy characterizes the electrohydrodynanic motion of EGaIn in capillary systems.

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