Abstract Submitted
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Different Shades of Oxide: Wetting Mechanisms of Gallium-based Liquid Metal Drops[1] KYLE DOUDRICK[2], SHANLIANGZUI LIU, Arizona State University, EVA M. MUTUNGA, KATE L. KLEIN, University of the District of Columbia, VIRAJ DAMLE, Arizona State University, KRIPA K. VARANASI, Massachusetts Institute of Technology, KONRAD RYKACZEWSKI, Arizona State University — Gallium-based liquid metals are of interest for a number of applications including biomedical devices, flexible electronics, and soft robotics. Yet, device fabrication with these materials is challenging because they adhere strongly to majority of common substrates. This unusually high adhesion is attributed to the formation of a thin gallium oxide shell, however, its role in the adhesion process has not yet been determined. Here, we show that, dependent on formation process and resulting morphology of the liquid metal-substrate interface, Galinstan adhesion can occur in two modes. The first mode occurs when the oxide shell is not broken as it comes in contact with the surface. Because of the nanoscale topology of the oxide, this mode results in minimal adhesion between the liquid metal and most solids, regardless of substrate's surface energy or texture. In the second mode, the formation of the Galinstan-substrate interface involves breaking of the original oxide skin and formation of a composite interface that includes contact between the substrate and pieces of old oxide, bare liquid metal, and new oxide. We show that in this mode Galinstan adhesion is dominated by the new oxide-substrate contact.

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