

Native Oxide of Liquid Metals: A New Class of Surfactant

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Gallium (Ga) based liquid metals (LM), such as pristine Ga, eutectic gallium–indium (EGaIn), and Galinstan have wide variety of applications such as stretchable electrodes and soft actuators by sub-micro patterning, 3D printing, and 2D material synthesis. It is suspected that the oxide skin of the LM is responsible for the unique interfacial behavior, such as metastable 3D configuration or extremely thin puddle or film. Despite of devotion to reveal its interfacial properties, the interfacial energy between the oxide skin and LM is still not investigated. Here, we directly measured the interfacial energy between the oxide skin and LM. It was revealed that the oxide skin lowers the interfacial energy of LM about 58 times compared to the surface tension of LM in inert atmosphere. Conventional surfactant lowers the interfacial energy via polar interaction with the polar molecules. Likewise, we suggest the native oxide skin lowers the interfacial energy via metallic interaction (or metallic bonding) with the inner liquid metals and lower the interfacial energy. With these findings, we successfully understood the interfacial behaviors LMs.