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Shape reconfigurable liquid metals

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SHAPE RECONFIGURABLE LIQUID METAL

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Shape often defines the function of materials. Shape reconfigurable materials are those that can change shape (and thus, function) in response to a stimulus. We have been studying new methods to pattern and control the shape of a micromoldable liquid metal and embed it in functional polymers to create conductors that are soft, self-healing, ultra-stretchable, and shape reconfigurable. The metal is a gallium-based metal alloy that is a low-viscosity liquid at room temperature with low toxicity and negligible volatility. Despite the large surface tension of the metal, it can be molded into non-spherical shapes due to the presence of an ultra-thin oxide skin that forms on its surface. Because it is a liquid, the metal is extremely soft and flows in response to stress to retain electrical continuity under extreme deformation. Recently, we reported that electrochemical reactions can be harnessed to deposit or remove the oxide skin that forms on the metal[1]. Surprisingly, the deposition of the oxide results in a dramatic reduction of the surface tension, which implies the oxide acts like a surfactant. Thus, changing the polarity of the voltage applied to the metal results in very large changes in surface tension, which can be harnessed to control the shape of the metal (Figure 1). This talk will discuss the properties of this liquid metal, applications, and the underlying science that enables shape reconfigurability. We believe the ability to move and manipulate metals on the micro-scale is particularly attractive for composites since it could allow for the ability to tune the shape of metallic (electrical, thermal) structures inside composite materials using only voltage.

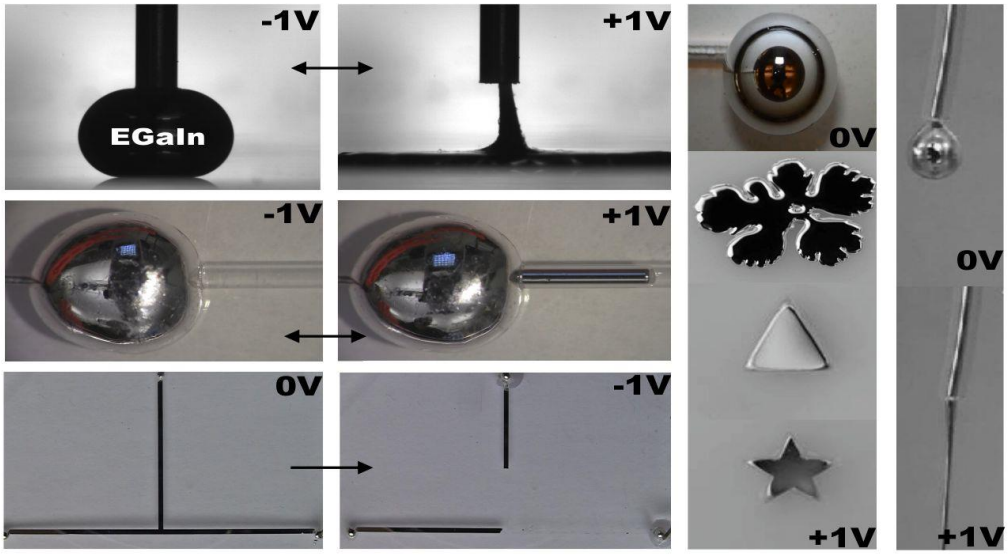

Figure 1 – Liquid metal (eutectic gallium indium, EGaIn) forms a surface oxide that can be controlled electrochemically to manipulate its shape.

References:

1. Khan, M. R., Eaker, C. B., Bowden, E. F. & Dickey, M. D. Giant and switchable surface activity of liquid metal via surface oxidation. *Proc. Natl. Acad. Sci.* **111,** 14047–14051 (2014).