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Oxide-Mediated Fingering Instabilities in Liquid Metals KAREN DANIELS, COLLIN EAKER, DAVID HIGHT, JOHN O'REGAN, MICHAEL DICKEY, North Carolina State University — Fluid instabilities that form repeating, self-similar patterns are seen in a variety of natural and laboratory phenomena. Liquid metals are an unlikely candidate for these types of instabilities due to the large energetic penalty associated with increased surface area, yet these instabilities can be driven by electrochemical oxidation of a droplet in an aqueous solution. This oxidation lowers the effective interfacial tension of the metal, thereby inducing drastic and reversible shape changes in a gallium-based liquid metal alloy. We demonstrate via a box-counting method that the fractal dimension ($D = 1.3 \pm 0.05$) of the spreading metal places it in a different universality class than viscous fingering or diffusion-limited-aggregation ($D = 1.713 \pm 0.003$). By characterizing the volume and electric potential dependency of the shape change over time, we show that a growing surface oxide layer both creates and suppresses instabilities. Promoting and suppressing these instabilities may be useful for shape reconfigurable electronic, electromagnetic, and optical devices that take advantage of the metallic property of the liquid.

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