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Compact Two-Liquid Microfluidic Hyperelastic Capacitive Strain Sensors[1] SHANLIANGZI LIU, XIAODA SUN, KONRAD RYKACZEWSKI, Arizona State University — Applications of liquid metal microfluidic devices include flexible electronics, biomedical devices, and soft robotics. In addition to single channel resistive strain sensors, two channel capacitive sensors have also been developed. However, these capacitive strain sensors have low capacitance with a footprint of about a square centimeter, making strain-output correlation quite complex [1]. To address this issue, we developed a compact two liquid single straight channel capacitive strain sensor with a dielectric liquid sandwiched between two liquid metal electrodes. Formation of the capacitor with a liquid dielectric instead of PDMS enables capacitance increase through selection of high permittivity liquid. Using a custom experimental setup, we show that use of water and glycerol instead of silicone oil in-between the liquid metal electrodes can increase the device capacitance by fivefold. We discuss the effect of channel diameter, dielectric spacing, interfacial meniscus shape, and the liquid flow on device capacitance as well as response to strain. In addition, we discuss the effect of gallium oxide shell formation at the dielectric-liquid metal interface.

[1] Fassler A. and Majidi C. Smart Mater. Struct. 22 (2013).

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