Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Controlling Surface Chemistry of Gallium Liquid Metal Alloys to Enhance their Fluidic Properties NAHID ILYAS, BRAD CUMBY, ALEXANDER COOK, MICHAEL DURSTOCK, CHRISTOPHER TABOR, Air Force Research Laboratory, MATERIALS AND MANUFACTURING DIRECTORATE TEAM — Gallium liquid metal alloys (GaLMAs) are one of the key components of emerging technologies in reconfigurable electronics, such as tunable radio frequency antennas and electronic switches. Reversible flow of GaLMA in microchannels of these types of devices is hindered by the instantaneous formation of its oxide skin in ambient environment. The oxide film sticks to most surfaces leaving unwanted metallic residues that can cause undesired electronic properties. In this report, residue-free reversible flow of a binary alloy of gallium (eutectic gallium indium) is demonstrated via two types of surface modifications where the oxide film is either protected by an organic thin film or chemically removed. An interface modification layer (alkyl phosphonic acids) was introduced into the microfluidic system to modify the liquid metal surface and protect its oxide layer. Alternatively, an ion exchange membrane was utilized as a sponge-like channel material to store and slowly release small amounts of HCl to react with the surface oxide of the liquid metal. Characterization of these interfaces at molecular level by surface spectroscopy and microscopy provided with mechanistic details for the interfacial interactions between the liquid metal surface and the channel materials.

Nahid Ilyas
Air Force Research Laboratory

Date submitted: 07 Dec 2015 Electronic form version 1.4