Electric Current Induced Mass Transport in Liquid Metals: Phenomenon and Applications

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Abstract

Liquid metals can be transported over long distances by applying an electric current (or field). With a few exceptions, the liquid metal flows in the direction of applied current and is thought to be driven by a diffusional process called liquid electromigration. In this talk, we will discuss the fundamental aspects of the transport phenomenon, such as the effects of current density, electric field, temperature and substrate surface conditions. Liquefaction upon application of electric field can be a reliability issue, such as in extended very thin infinite films in MEMS and microelectronic devices; however, it can also engender many applications where controlled delivery of liquid metals is desired, such as micro-fluidics, patterned conformal-coatings, lithography, nano-soldering, etc. Some of these applications will be discussed.

Brief Bio

Praveen Kumar received his Bachelor of Technology degree in Mechanical Engineering from the Indian Institute of Technology, Kanpur (India) in 2003. Subsequently, he received M.S. and Ph.D. degrees in Mechanical Engineering, with emphasis on Materials, from the University of Southern California, Los Angeles (USA) in 2005 and 2007, respectively. He joined the Department of Materials Engineering at the Indian Institute of Science, Bangalore (India) in May 2011 as an assistant professor and he has been working therein as a professor since May 2023. His main research interests are the mechanical behavior of materials, with particular emphasis on studying the effects of electric current, temperature and sample length scale, and constructive usage of electromigration, both in solid and liquid metals. His works involve structure-property relationships to gain fundamental insights into structural integrity of structures, and the findings have been published in more than more than 140 journal articles. He has received scientific awards including Abdul Kalam Technology Innovation National Fellowship from the Indian National Academy of Engineering (2022-2025), Young Scientist Award from the Indian National Science Academy (2016), etc.

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