In-situ electron microscopy using MEMS based devices and Graphene liquid cells

Sairam K Malladi

Department of Materials Science and Metallurgical Engineering, Indian Institute of Technology Hyderabad, Kandi, Sangareddy, Telangana 502285

* *srkm@msme.iith.ac.in*

Over the years, Transmission Electron Microscopy (TEM) has been a primary characterization tool to understand the structure-property relationship of most of the materials. In most of the studies, the specimens are investigated post-mortem. There have been several successful attempts to carry out in situ TEM experiments wherein dynamic changes in a specimen are investigated while applying a stimulus like heating, electrical bias, mechanical deformation or exposing to a reactive environment. Owing to the advancements in TEMs and micro-electro-mechanical systems (MEMS), the area of in-situ TEM has progressed extensively over the last decade. Some notable in-situ TEM studies using MEMS devices are applications such as heating, electrical biasing, gas environmental TEM studies as well as liquid cell studies to understand the mechanisms for phenomena in materials science as well as life sciences. Apart from the MEMS devices, there have been recent developments as well as promising applications using graphene as encapsulating membranes for liquid cells. In this talk, a few examples of MEMS based heating devices as well as graphene liquid cells to understand the microstructural evolution in metallic thin films as well as growth of nanoparticles will be discussed. These recent studies using MEMS devices and graphene liquid cells show that graphene liquid cells are the most promising candidates for static-liquid cell experiments, the application of graphene for liquid flow-cells is still in a nascent state. In addition to the mechanisms, some of the issues pertaining to design, fabrication and challenges while carrying out in-situ TEM experiments using MEMS based devices and graphene liquid cells will be highlighted.

Keywords: in-situ TEM, MEMS devices, in-situ corrosion, in-situ heating, phase transformations, graphene liquid cells