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IT-13-P-1667 Method For Improving FIB Prepared TEM Samples By Very Low Energy Ar⁺ / Xe⁺ Ion Mill Polishing

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The great progress in development of new transmission electron microscopes (TEM) during the last two decades has reached a point where the main limiting factor for obtaining fully quantitative and reliable information at the atomic scale is not the optics or the stability of the microscopes but rather the quality of the investigated specimen. The quality of a TEM specimen is determined by how thin and transparent it is to electrons, the surface roughness (variation in local thickness), and the amount of amorphization of the free surfaces (top, bottom and edges) of the specimen.

Well established methods for preparing TEM samples, such as mechanical polishing and electro-chemical polishing, are available. These methods provide very good quality samples when large structures or interfaces are present. When nano-scale site-specific investigation is needed, the best method available is the dual focused ion beam (FIB). This method uses a focused Ga⁺ ion beam to thin the area of interest down to few tens of nanometers. The ion bombardment of the specimen surface can introduce various artifacts, such as surface amorphization, Ga⁺ ion implantation, cratering and material re-deposition. These artifacts can be partially reduced by lowering the Ga⁺ ion energy down to 2 KeV.

For fully quantitative high resolution TEM studies, one needs to get the thinnest possible sample and remove completely all the artifacts introduced by the FIB. This can be achieved by further milling of the FIB sample using well controlled low energy (0.2-0.5 KeV) Ar⁺ / Xe⁺ ion milling.

Here we present a method to improve various FIB prepared TEM samples using low voltage ion polishing. This method provides a quick and fairly easy way to prepare high quality TEM samples for fully quantitative and reliable studies.