Atom Probe Tomography of Thin Film Materials

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Multilayer thin film structures, which are formed by alternate deposition of two or more different elements or compounds, have a range of technologically important applications including magnetic recording media. The nature of the interfaces between the layers and between grains is important in determining the properties of these thin films. Atom probe tomography has sufficiently high spatial resolution to characterize local structure and composition of multilayer thin film devices at the atomic scale. This technique enables the x, y and z coordinates and the mass-to-charge ratio, and hence the elemental identity, of all the atoms in a small volume to be determined with near atomic resolution. However, the preparation of field ion specimens from these planar structures is difficult. In order to examine these types of materials in the three-dimensional atom probe, a sharply pointed needle with an end radius of ~50 nm that contains the layers of interest in the apex region is required. The use of a focused ion-beam allows suitable specimens to be made and to concurrently monitor the fabrication process by imaging with secondary electrons. This specimen fabrication method permits the observation of the structure of these devices, including individual film thickness and curvature as well as grain boundary properties. In addition, the correlation of structural and chemical observations with magnetic property data from the same thin film structure may be accomplished.

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