DETERMINATION OF ACTIVATION ENERGY IN TEXTURED METAL-METAL MULTILAYER FILMS VIA 2D XRD

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Metal-metal multilayer thin films have found use in many electronic, optical and magnetic applications. In order to estimate the thermal stability of multilayer films, we investigated the behavior of films subjected to slow heat treatment at moderate temperatures (~100–300 ^{o}C). XRD analysis observed intensity decay for diffraction peaks associated with the constituent metal phases due to inter-diffusion of the differing metal bilayer species (e.g., Al/Pt and Ni/Ti). This slow diffusion process is important with regard to long term functionality of the film. Monitoring the peak intensities of the decaying chemical species as a function of temperature allows the derivation of the activation energy for the diffusion reaction in the metal-metal multilayer films. However, there is one caveat — the metal layers often demonstrate significant out-of-plane texture. The peak intensity decay due to reaction may also be coupled with significant increase of mosaic spread of the decaying peak intensities. Hence, there are two possible sources of intensity loss which makes quantification difficult with standard 2 analysis. We therefore have employed an area detector methodology to monitor both peak intensity loss and mosaic spread in order to better derive the activation energy of textured films. The results of this method for the determination of activation energies in various multilayer film systems will be presented.

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