Dynamic diffusion rates during evolution of Mo-Si interlayers under annealing

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Abstract

Interdiffusion properties of Mo/Si multilayered films with different morphology of the interlayer between the Mo and Si layers were studied using *in-situ* small angle x-ray reflectometry during annealing in a temperature range of 200-325°C. In order to obtain different morphologies of the interlayers, we pre-annealed some of the samples at 350°C, before determining the diffusion properties in the quantified temperature range. This pre-treatment caused a crystallization of the Mo-Si interlayer, visible from XRD measurements. We observed that the determined activation energy for interdiffusion of an interlayer in the crystalline state is considerably higher than for an interlayer in an amorphous state. Furthermore, the diffusion rate at fixed temperatures decreases gradually as a function of time caused by an increase of the activation energy. We also observe that the activation energy appears to be a limiting factor for interdiffusion at temperatures below 300°C. Above this temperature the proportionality constant for diffusion starts to become the dominant factor, probably related to the diffusion along grain boundaries of the nano-sized crystallites which form in the course of the pre-annealing.