Mo/Si interdiffusion and B_4C diffusion barrier performance studies using High-Sensitivity Low-Energy Ion Scattering (HS-LEIS).

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Mo/Si multilayer mirrors with a 6.9 nm periodicity will be used as optics in EUV-lithography (13.5 nm wavelength). Unfortunately, the lifetime of the mirrors is limited because of interdiffusion. Interdiffusion reduces the optical contrast and therewith the reflectivity of Mo/Si multilayer mirrors. Moreover, the period changes because of the higher density of the formed compound ($MoSi_2$) with respect to the densities of Mo and Si, thus changing the reflected wavelength. Thin B_4C-layers are regularly applied in between Mo and Si layers to reduce the interdiffusion. On one hand, this diffusion barrier layer should be thinner than 0.5 nm to prevent loss of reflectivity due to the unfavorable optical constants. On the other hand however, the barrier layer has to be thick enough to form a closed layer and truly act as a diffusion barrier. In order to find this critical thickness, the interdiffusion was studied as a function of B_4C thickness. c-Mo/B_4C/α-Si test samples were simultaneously annealed and analyzed following a new approach, namely exploiting the depth resolution of High-Sensitivity Low-Energy Ion Scattering (HS-LEIS) (3 keV He^+). HS-LEIS was the analysis technique of our choice because it provides accurate compositional information with a high depth resolution (sub-nm resolution feasible) and a proper time resolution (~1 minute). It was found that this new approach is suitable for monitoring the diffusion *in situ*, and that diffusion coefficients can be derived from this.

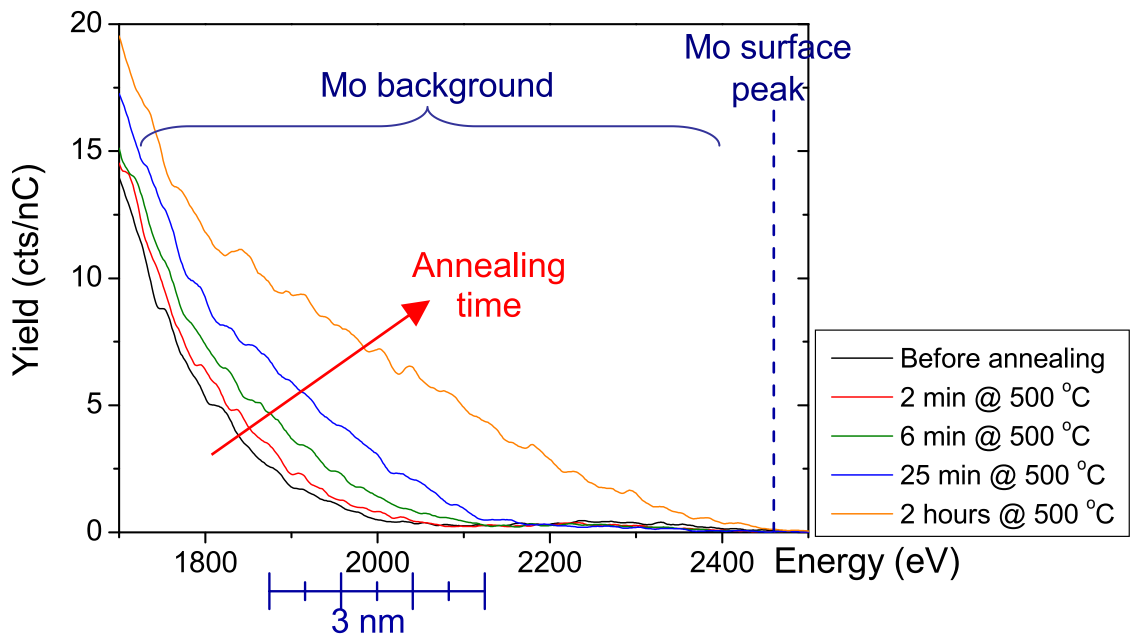

Figure 1: the evolution of the HS-LEIS spectrum during annealing at 500 °C. It reflects the diffusion of the Mo towards the surface, because the energy-scale can be converted to a depth-scale (as indicated by the scaling bar).