MAT Science Week
April 24-27, 2018 at GSI, Darmstadt

Beitrag ID: **35** Typ: **Oral**

Development of In-situ X-Ray Diffraction Measurements during Low Energy Ion Beam Etching

Mittwoch, 25. April 2018 11:00 (20 Minuten)

In-situ X-ray diffraction measurements following the details of ion nitriding of stainless steel have been developed during the last 5 years. Nevertheless, the amount of local information is limited as diffusion and relaxation processes due to the elevated temperature during the process will lead to dynamic processes difficult to be resolved as a function of depth. On the other hand, mechanical polishing of layered systems to gradually remove material and successive analysis by XRD is an established and accepted method.

Here, we propose to use low energy ion beam etching coupled with in-situ XRD to obtain detailed, depth-resolved data. Limiting the ion energy to 1 keV or less will lead to minor modifications of material, avoiding potential plastic or elastic deformation during mechanical removal, restricted to the immediate surface zone of only up to 10 nm. At the same time, the XRD information depth is between 2 and 100 µm, conditional on the specific materials system. With a current density near 100 µA/cm2, a depth resolution of 15 –25 nm per spectrum can be realized. The analysis of the results can be performed using the intensity of reflections from the layer system as well from an underlying substrate. As the experimental setup is constrained to Bragg-Brentano geometry, surface roughening may result in a continuously degrading depth sensitivity.

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Sitzung Einordnung: Mat Science Week

Track Klassifizierung: Annual Workshop on Ion and Particle Beams (Ionenstrahl Workshop)