ORE303

In-situ XRD for details on expanded austenite formation

Stephan Mändl, Patrick Schlenz, Jürgen W. Gerlach, Darina Manova

Leibniz Institute of Surface Engineering, Leipzig, Germany

stephan.maendl@iom-leipzig.de

While the formation of expanded austenite by nitrogen insertion into austenitic stainless steel is an established process, the exact nature of this metastable expanded phase and its stability limits are still under investigation. Combining ion beam sputtering with X-ray diffraction measurements permits fundamentally new insights into the structure of this expanded phase. Sequential $^{14}N/^{15}N$ ion implantation was performed for 1 keV nitrogen ions combined with a fast *in situ* XRD system. At 370 °C, the initially implanted isotope is diffusing found deeper than later implanted isotope. With increasing temperature, the intermixing of both isotopes becomes more pronounced. A strong correlation between this trapping of the initially implanted isotope and the onset of CrN formation is observed. For the extreme case of a closed CrN layer near the surface nitrided at 550 °C, the initially implanted isotope is distributed closer to the surface than the second implanted isotope.
XRD analysis of expanded austenite formed in steel 1.4571 yields the identification of an “anisotropic lattice expansion”. However, two differently oriented types of crystallites are probed and only one lattice orientation of each group is actually measured. For layered and strongly textured systems with a thickness of 1–5 µm conventional XRD provides only limited information. Depth-resolved XRD measurements using ion-beam etching with Ar ions at 1 keV indicate that the {200} oriented fcc grains are representing two separate expanded phases: the phase with a larger expansion perpendicular to the surface is on top of the phase with a smaller expansion. Complementary *ex situ* XRD measurements show a detailed comparison of these two phases while additional *in situ* investigations during growth by low energy ion implantation demonstrate the observation of the transition between these two phases as function of the thickness of the expanded austenite layer.

Keywords
Plasma diffusion
XRD
expanded austenite