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Elemental Segregation Observed for Decaying Expanded Austenite

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Formation of expanded austenite by nitrogen insertion into austenitic phases including austenitic stainless steel, CoCr and Ni base alloys is a well-established phenomenon. Similiarly, the thermally activated decay into Cr-N precipitates and a Cr-depleted matrix has been known for a long time. However, exact evidence on atomic transport and growth of these precipitates on a nanometer scale is hard to come by. Using in situ X-ray diffraction (XRD) measurements during low energy nitrogen ion implantation into steel AISI 304 followed by fast and short annealing allows the formation of a graded structure with complete decay at the surface and the expanded phase at a depth of less than 5 µm. Thus, transmission electron microscopy (TEM) investigations of a single sample allows the investigation of the time, respective depth dependent decay of this expanded phase with coalescing and growing CrN precipitates and the elemental segregation associated with this decay: Fe and Cr are rapidly separated while Ni agglomeration in the Cr and N depleted zones is slower.

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