# Modification of surface morphology of austenitic-like FCC alloys induced by plasma assisted nitriding

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**Abstract**

When performed at moderate temperature (typically lower than 450∘C), nitriding of Fe, Co or Ni-based metallic alloys exhibiting an austenitic phase (or $\gamma$ phase) leads to the incorporation of nitrogen in the face centered cubic cells, up to 25-35 at.%, giving rise to the growth of the metastable "expanded" nitrided phase usually called $\gamma$N phase or S phase The expansion of the cells is responsible for the high compressive stress level usually observed in the nitrided layer. These compressive stresses induce a significant elasto-plastic response of the materials which in turn modify the morphology of the treated surface. The present work focuses on these induced modifications observed after plasma assisted nitriding at 400∘C of several kinds of alloys with an austenitic matrix: austenitic stainless steel 316L ,CoCrMo and Ni-based superalloys like Haynes®230, Udimet® 720, Inconel®718 and N18. Scanning electron microscopy was used to observe the microstructure evolution and particularly emerging slip bands showing that plasticity mechanisms operate. The colossal expansion of the unit cells in the $\gamma$N phase (up to 10%) was determined from X-ray diffraction whereas white light interferometry enabled to quantify the global swelling of the surface due to the elasto-plastic behaviour of the materials. The anisotropy of swelling is related to the anisotropic behaviour in nitrogen diffusion and/or in the plastic mechanisms. Annealing at 650∘C for 23h under neutral atmosphere performed on some samples leads to chromium nitrides precipitation and redistribution of nitrogen content on a thicker depth; the induced modifications of the surface topography can be explained by the relaxation of the residual compressive stress due to the lowering of the nitrogen content in the $\gamma$ phase.

**Keywords:** $\gamma$ phase, swelling, plasma nitriding, expanded $\gamma$n phase, plasticity

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