# Study of nitrogen implanted aluminum bulk formability, influence of initial microstructure.

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**Abstract**

It is well known that ion implantation into metals allows lifetime increase of functional surfaces [1]. However, the technical complexity of the particle accelerators, combined with the high doses required for improvement of metal properties, reserves metal treatment by ion implantation only for finished and high added value products. The advances in both industrial vacuum [2] and particle accelerator [3] technologies lead us to consider ion implantation as a potential surface treatment for semi-finished product. As a consequence the product should undergo various thermo-mechanical treatments after the ion implantation phase. The behaviour of aluminum bulks under nitrogen irradiation needs to be studied in order to optimise the ion implantation step.

In this study, we examine the superficial aluminium hardness and wear behaviour improvements under nitrogen implantation and the correlated surface morphology modifications. Implantations were performed by mean of the QUERTHOR®,[2] implantor. QUERTHOR® uses a miniaturized Electron Cyclotron Resonance accelerator allowing intense and multi-charged ion-beam production. N-implantation into Al-1050 sheet, allowed a superficial-hardness increase from 0.2 to 15 GPa, and a friction coefficient decrease from 1 until 0.2. These results are correlated to the microstructure of implanted aluminium as measured using XPS and grazing-incidence XRD. The implanted samples were then submitted to temperature ageing and mechanical stresses in order to evaluate the influence of the nitride layer on the bulk aluminum formability. The influence of the initial microstructure on the implanted sample behaviour is also investigated. Influence of crystallographic orientation of aluminum on implantation-induced hardening was shown. The present work allowed us to evaluate the limits of formability of implanted aluminum for various initial microstructures, which represent different formability process steps incorporating ion implantation.

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