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Effects of ion-beam bombardment and nitridation on physical/mechanical properties of 100Cr6 TiN coated steels

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The development of new processes to improve the adhesion and growth of wear resistant coatings on wear parts and cutting tools is a challenging task. Such processes aim to modify the surface of the substrate at atomic level by forming new phases, by inducing internal stresses or by tailoring the surface topography. In the ion beam bombardment process it is known that relatively low bombardment energies (~100-1000 eV) of steel substrates by heavy inert ions (Ar^+, Xe^+, Kr^+) improves the diffusion of nitrogen due to surface cleaning, generating local stresses and grain size refining of the material's surface. Furthermore, the pre-treatment of steel substrates surfaces by using heavy ions bombardment and posterior N^+ ion beam nitriding process could thus be used to get surfaces suitable prepared for hard coatings deposition, i.e. a controlled pre-ion bombardment preparation of the surface is added to the well known “duplex” process.
In this work TiN hard coatings were deposited on 100Cr6 steel substrates with surface modified by combining Xe^+ ion pre-bombardment and posterior nitriding treatment by N^+ implantation. All processes (pre-ion bombardment/nitrogen implantation/coating) were sequentially performed *in-situ* in an ion beam assisted deposition (IBAD) system. The physical effects of the pre-treatment on the substrate were analyzed according to their crystalline structures, grain sizes, Xe atoms remaining in the sample and the residual stress state induced in the material surface. Correlations between surface pre-treatment and TiN coating adhesion and wear resistance are presented and discussed.

Keywords
Surface modification
Ion-beam bombardment
Nitridation
TiN coating
Internal stresses