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**Fracture toughness of TiAlN hard coatings with soft metal inclusions**Martin Andritschky<sup>1</sup>, Romain Waidelich<sup>2</sup><sup>1</sup>Centro de Física, Universidade do Minho, Minho, Portugal <sup>2</sup>Inorcoat, Plovdiv, Bulgaria

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Fracture toughness and adherence are crucial for the performance of hard ceramic coatings in multiple applications such as punching, stamping, forming or printing application. Of course, due to the wear in these applications, the coating should also be hard. In the present work we developed a tough TiAlN coating by adding a metallic phase during the sputtering process. The mechanical properties of the coating were evaluated quantitatively based on the H/E ratio the scratch resistance and during the Rockwell C adhesion evaluation. A qualitative evaluation of the coating hardness was done based on the cracking patterns during scratch test and Rockwell C impression.

The PVD Coating was done in an industrial MS 1400 sexta, a 6-magnetron coating machine from Inorcoat using the patented Magnetron Sputtering cathodes. The machine allows an asymmetric nitrogen distribution in the coating chamber, allowing the simultaneous deposition of the ceramic TiAlN and metallic Cu. The metallic Cu was deposited in the form of nano-inclusions in the ceramic matrix and in the form of intermediate layers, giving the coating architecture a sandwich like structure.

TiAlN can be deposited in the Inorcoat machine as a well adherent (critical load > 90 N during scratchtest), hard ( $HV_{0.005} = 3\ 300$ ) coating on Ni substrates. The inclusion of Cu reduces, obviously, the hardness, but increases the H/E ratio. The cracking pattern during scratch test and Rockwell C indentation changes, the cracks become shorter with an increased spacing.

**Keywords**

Ceramic coatings  
Fracture toughness  
Adherence  
TiAlN(Cu)  
Metallic inclusion