Workshop »Coatings for Tools & Components«

Plasmanitriding before Coating

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Only in very rare cases are coatings usable in the free standing form without a substrate. The usability of the coatings excellent wear and corrosion resistance properties most often rely on support from the substrate material. Coatings are mostly deposited on two categories of substrates: Ferrous material including steel and cast iron and non-ferrous materials such as cermets, ceramics and carbides. In case of ferrous alloy, including commonly coated high speed steels, nitriding is a possible mean to increase the load bearing capability of the substrate.

Nitriding leads to the formation of a hardened surface layer including compressive instrinsic stresses. This increased hardness of the substrate reduces plastic deformation of the substrate. Typical hardness on D2 tool steel reach values of 1200 HV0,2. Furthermore nitriding can result in the formation of a so called white layer consisting of Fe_4N and Fe_3N phases. The white layer (on D2) shows typical values of 16 GPa of indentation hardness and 250 GPa of indentation modulus. Both values are in between typical substrate and coating hardnesses. The increased modulus also reduces the mis-match in elasticity between substrate and hard-coating.

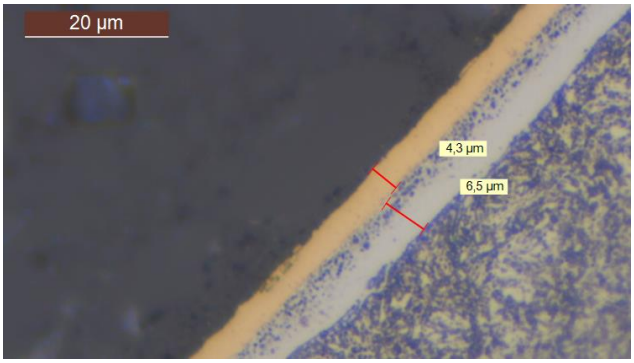

Figure 1: adherent titanium nitride on thick white-layer

Figure 2: TiAlN on minimal white layer

Conventional wisdom is that PVD coatings do not adhere to nitrided substrated. Contrary observations have been done on plasma nitrided steels. The correct plasma nitriding techniques allow adhesion of Titanium and Chromium based hard coatings to nitrided substrates including white layer as well as to substrates with supressed white layer formation. Free choice of parameters allow the creation of both conditions with adherent layers so the choice can be made on application requirements, foremost the compromise between roughness, toughness and wear properties.