

Protective hard ceramic coatings deposited via High Power Impulse Magnetron Sputtering

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Hard ceramic coatings were designed to meet very different technological issues of components employed for extreme conditions. They can be deposited on a wide variety of substrates in order to improve one or several properties, while not changing bulk material performance.

PVD technologies are among the most appealing for achieving high quality coatings, and they are also well developed on an industrial scale. In this work, the latest High Power Impulse Magnetron Sputtering (HiPIMS) technology was employed to grow high density, smooth ceramic coatings, with enhanced film/substrate adhesion also on complex-shaped surfaces.

An important type of high-quality ceramics are nitrides: adding nitrogen to a crystal lattice made of transition metals atoms, produces special systems having unique features.

Among these materials, titanium aluminium nitride (TiAlN) is extensively applied for many different technological uses due to its high hardness, great oxidation resistance and outstanding tribological properties, also at elevated temperatures.

Vanadium nitride (VN) is considered a promising alternative material for coatings because of its attractive mechanical properties, good thermodynamical stability and corrosion resistance. In particular, it has been investigated to coat cutting tools. Indeed, at high temperature, VN starts oxidizing and produces various lubricious VO_x phases (i.e. Magneli phases).

Finally, titanium diboride (TiB_2) represents a potential nitrides substitute material for some film applications because of its high temperature oxidation protection due to its high melting point (3490 K), thermal stability and high strength to density ratio. Moreover, TiB_2 shows high hardness, superior Young's modulus and abrasive wear resistance. Finally, thanks to its low wettability, it is particularly suited for non-ferrous alloy machine tooling applications, when a strong buildup edge forms.