

TI-FREE PVD HARD COATING

Student gr. ПБ-81 (undergraduate) Podolianets Pavlo

PhD, Prof. V.S. Antonjuk

National Technical University of Ukraine "Kyiv Polytechnic Institute"

Ti-based coatings represent the state-of-the art for PVD hard coatings used in industrial machining applications. However, new challenges mainly in the field of metal cutting as well as in stamping and forming applications need continuous improvements. Besides mechanical and physical properties, oxidation resistance and the affinity between the workpiece material and the tool are very important for further developments. These properties can be influenced on the one hand by various deposition parameters and coating technologies but also by a certain chemical composition of the elements used for the coatings.

Recently, a new generation of Ti-free PVD-coatings were introduced, based on the Al-Cr-N system. This system is characterized by superior abrasive wear resistance and improved oxidation resistance. It is need to mention that if the oxidation resistance and abrasive wear resistance of the coatings can be optimized simultaneously a significant increase in the tool life can be achieved.

According to abrasive wear coefficients of the next coatings the abrasive resistance of AlCrN coating is better by factor 3-5 comparatively to AlTiN and TiAlN coatings correspondingly.

Besides, the coating with the best oxidation resistance (upon TiAlN, AlTiN, TiCN and AlCrN) was AlCrN. Even at 1100°C only a thin oxidation layer of about 150 nm in thickness could be observed. When TiAl-based nitrides (TiAlN, AlTiN) were stable against oxidation up to temperatures of only about 800°C and TiCN-coating just about 600°C.

As a result, AlCrN coating has high results in machining application. In particularly in a high speed machining operation in medium carbon steel a tool life of about 130 m was reached. Thus, nearly no flank wear could be detected up to a tool life of about 100m. In comparison, a tool lifes of TiAl-based coatings and TiCN coating at the same conditions were near 60 and 40 m respectively.

Aforementioned information gives a comparison between state-of-the-art Ti-based PVD hard coating and a Ti-free AlCrN-coating. Besides coating properties, also machining application are compared.

It could be shown that due to the excellent oxidation and wear behavior of high aluminum content AlCrN coating big step in improvement in machining application could be achieved. As this coating is quite new in the cutting tool market, further machining test have to be done to define the potential for this type of coating.

References

1. Kalss W et al. Refractory metals & hand materials 2006;399-404:24