

ORB103

Low temperature PVD hard coatings

Hannes Joost, Florian Welzel, Heiko Frank

GFE Schmalkalden e.V., Schmalkalden, Germany

h.joost@gfe-net.de

PVD hard coatings are well established to improve the properties of tools and components, especially with regard to mechanical wear resistance. One advantage over CVD coating procedure for example is the lower coating temperature (normally 400 - 500 °C). But there are also materials which need a lower process temperature. Especially during the coating deposition on light metal alloys or low tempered steels there can lead to a change of microstructure which influences the material properties negatively. Furthermore, bonded tools are now more and more state of the art, in which the organic or inorganic adhesives have a limited temperature resistance. For these applications, it is necessary to reduce the deposition temperature down to about 200 °C to improve the applicability of the PVD deposition process. In various investigations, process analysis and adaptation were used to determine the effects of deposition temperatures on layer formation and coating properties. Goal was to develop a coating strategy/technology with a significantly reduced deposition temperature. The challenge here is the limited particle mobility and diffusibility of the adatoms, which leads to a higher error density and lower crystallinity. In many layer systems that were deposited at a reduced temperature an increase in microhardness and elastic modulus can be reached, but also an effect of embrittlement can be detected. This effect is not only based on the thermal conditions, but also correlates with the lowering of the cathode currents and reflects the effect of the reduced particle mobility. Based on the investigations, the deposition temperature of PVD-multifunctional coatings can be reduced to temperatures < 200 °C. With an optimized deposition strategy high-performance AlTiCrN multilayer coatings with a high hardness (> 40 GPa) and increased coating adhesion ($L_c2 > 70$ N) were successfully deposited on carbide tools and tested in milling applications.

Keywords

PVD
coating
wear resistance
low temperature
process