Carbon based wear protective coatings deposited by plasma-assisted high-rate electron beam evaporation

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The reduction of costs is a permanent demand for the coating industry is. The increase of the deposition rate is a typically used way therefore. That's why we tested the possibilities of the high rate electron beam evaporation in combination with powerful plasma processes to produce carbon based coatings. This material class is of great interest for many applications, especially for tribological and wear resistant coatings.
We will present in detail the used experimental technique of the plasma-activated high-rate electron beam technology, which allowed us to deposit carbon based tribological coatings with remarkable higher rates in the order of 100 nm/s. In different evaporation configurations we obtained hydrogen free as well as hydrogen containing amorphous carbon layers. Furthermore we modified the evaporation process to deposit titanium and tungsten containing amorphous carbon coatings.
Further on we present a few results of the analytical investigations. In the case of the used strong plasma activation during the evaporation a dense layer micro-structure was achieved. We discuss the results of the structure analyses by x-ray deflection measurements. For the characterization we measured basic mechanical properties like friction and wear in a pin-on-disc test with a steel ball without a lubricant under atmosphere conditions (5 mm, 25 mm/s, 1N). We could prove the friction of around 0.2 and the wear of around $1.5*10^{-15} m^3/(N*m)$. In dependency on the composition of the titanium containing carbon based coatings the measured micro hardness reached values up to 35 GPa in maximum.
The experiments and results give a new impression about the possibilities and the variability of the high-rate electron beam evaporation. The used processes are well adapted to large-area deposition for flat substrates like sheets and strips as well as for a very large amount of small parts.