OR1902

PVD Coatings Based on TiMgAlN and AlMgN and Substrate Pretreatment Concepts for AZ31-Magnesium Alloy

Stefan Groß[1], Holger Hoche[1], Torsten Troßmann[1], Matthias Oechsner[1], Juergen Schmidt[2]

[1]State Materials Testing Institute, TUD, Darmstadt, Germany [2]INNOVENT e.V. Technologieentwicklung, Jena, Germany

gross@mpa-ifw.tu-darmstadt.de

Magnesium exhibits high economic and ecological potential to save weight and fuel due to its low density and its high specific strength. Due to its bad corrosion resistance and weak wear properties, the surface has to be protected by coatings. The surface protection of by PVD coatings has the potential to open a wide range of applications for Mg alloys. Nevertheless, common PVD coatings cannot be applied to magnesium due to the risk of severe galvanic corrosion between substrate and coating. Therefore, new coating concepts have to be developed. Here, TiMgAlN and AlMgN are prospective coatings for a sustainable protection of the Mg against wear and corrosion.
Within the presented study, PVD-coatings based on TiMgAlN and AlMgN were deposited by an industrial PVD deposition unit type Cemecon CC800/9 using both, DC and HiPIMS technology. The coatings were examined concerning their chemical, structural and electrochemical properties.
The alloy content of Mg in the coatings varied between 1 at.-% and 60 at.-% for TiMgAlN and 1 at.-% and 33 at.-% for AlMgN. Increasing content of Mg influences the mechanical and electrochemical properties of the coatings in a positive way by solid solution hardening, refinement of the coating microstructure and shifting of the open circuit potential to more negative values. Application of HiPIMS sputtering further refines the coating microstructure and improves the hardness. The corrosion properties were examined by salt spray test and sophisticated electrochemical methods such as electrochemical impedance spectroscopy (EIS). Coatings were synthesized, which withstand at least 48h salt spray test without corrosion damage. Application of the EIS method allows the description of corrosion protection mechanisms. It will be shown, that the microstructural properties crucially influence the corrosion behaviour.

Keywords
Magnesium PVD-Sputtering
Corrosion
Coating characterization
Electrochemical Impedance Spectroscopy