Applied Research Activities

Empowering PVD for corrosion protection: TiMgGdN coatings with game-changing corrosion performance

Dr. Holger Hoche[1]*, Thomas Ulrich[1], Dr. Peter Polcik[2], Prof. Dr. Matthias Oechsner[1]
[1] Center for Engineering Materials MPA-IfW, Technische Universität Darmstadt, Darmstadt, Germany
[2] Plansee Composite Materials GmbH, Lechbruck am See, Germany

holger_claus.hoche@tu-darmstadt.de

Today, PVD technology is not the 1st choice for surface functionalization under corrosive conditions. Sate of the art for corrosion protection are multilayers of electroplating or chemical corrosion protection layers, followed bv a PVD top layer. This effects sustainability and economic factors in a negative way.

The authors successfully developed PVD-TiMgGdN coatings, sputtered with a powder metallurgical target in an industrial DC-magnetron PVD unit. With an only 5 µm coating thickness, corrosive mild steel substrates can be protected for at least 1000 h in the salt spray test against corrosion [1].

After experimentally improving the mechanical, microstructural and corrosive properties of these coatings, the mechanism of alloying MgGd into the TiN matrix will be explained. Therefore, binary TiN coatings were compared with TiMgGdN coatings regarding their microstructural, chemical, physical and corrosion properties. Corrosion properties were investigated by different corrosion tests. The coating surfaces were also analyzed by nanoidentation measurements and chemical analysis to gather knowledge of the coating stability during corrosive stresses.

It will be shown that the excellent corrosion performance is mainly influenced by the MgGd amount inside the coatings, which influences the open circuit potential between substrate and coating significantly. Moreover, the outcome of the investigations will show, that the MgGd amount has a minor influence on the mechanical coatings properties but a major influence on the resulting microstructure and the stability of the coating during corrosive stresses, which directly correlates with the corrosion performance.

[1] T. Ulrich, C. Pusch, H. Hoche, P. Polcik, M. Oechsner, Surface and Coatings Technology 422 (2021) 127496.