OR1702

Hunting growth defects in corrosion protective tribological hard coatings: Large area high resolution mapping as a tool for evaluating salt spray test results of TixMgyN films

Martin Balzer[1], Martin Fenker[1], Herbert Kappl[1], Thoralf Müller[2], Andreas Heyn[3], Alexander Heiss[1]

[1]fem, Schwäbisch Gmünd, Germany [2]BAM Federal Institute for Materials Research and Testing, Berlin, Germany [3]Otto von Guericke University Magdeburg, Magdeburg, Germany

balzer@fem-online.de

Hard protective coatings deposited by physical vapour deposition (PVD) methods have been characterised for decades for their corrosion protection capabilities. However, due to growth defects single PVD deposited hard coatings with a thickness below 10 µm are usually not capable to reliably protect steel substrates from corrosion in neutral salt spray (NSS) tests.
In this study, 2.5 µm thick TiN and TiMgN films with Mg-contents between 10 and 35 at.-% were deposited onto 1.3505 steel samples by DC magnetron sputtering. The growth defect concentration on each as-deposited sample was determined by large area high resolution (LAHR) mapping, a confocal microscopy based measurement and evaluation method recently introduced. The NSS test results were thus evaluated not only in relation to the Mg content, but also to the amounts and sizes of growth defects, which markedly reduced random influences. Further characterisations of the TiMgN-coated samples comprised hardness, tribological and electrochemical behaviour of the films as well as the microstructure of selected growth defects.
TiMgN with a high Mg content of 35 at.-% showed drastically improved corrosion protection capabilities for steel substrates compared to pure TiN. Coated polished as well as sandblasted samples showed almost no corrosion after 24 h in a NSS test. The defect concentration data further indicated an improved corrosion protection also for TiMgN with lower Mg contents. Cathodical corrosion protection was identified to be the main corrosion protection mechanism. The hardness of TiMgN with 35 at.-% Mg is markedly reduced, nevertheless it showed a good tribological behaviour against e.g. steel. This coating material hence demonstrates a unique combination of wear and corrosion protection properties.

Keywords
Growth defects
protective coatings
Titanium nitride
corrosion