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Combination of zinc alloy coatings with thin plasma polymer films for novel corrosion protective systems on carbon steel

Jessica Schindhelm[1], Krasimir Nikolov[2], Miroslaw Giza[1], Nicole Weiher[1], Bernd Schuhmacher[1], Claus-Peter Klages[2]

[1]Dortmunder OberflächenCentrum GmbH, Dortmund, Germany [2]IOT Institut für Oberflächentechnik, Technische Universität Braunschweig, Braunschweig, Germany

jessica.schindhelm@thyssenkrupp.com

Steel sheet used in automotive applications has to be effectively corrosion protected, which is usually realized by zinc or zinc alloy coatings with a thickness range of 5-10 µm. Steel sheet for especially corrosion stressed areas of a car body, e.g. cavity flanges or joints, may be additionally protected by a thin weldable organic coating with a thickness of 2-4 µm. A very promising approach to a significantly reduced use of resources is the combination of zinc alloy coatings with thin plasma polymer films deposited by means of plasma-enhanced chemical vapour deposition (PECVD). Such plasma polymer films of just a few 100 nm thickness show excellent barrier and adhesion properties as well as a high mechanical stability.
Within this work thin plasma polymer films were deposited on zinc alloy coated steel substrates using the Strip Hollow Cathode (SHC) method, which was modified for application on grounded substrates. A pulsed DC glow discharge in a mixture of argon and an organosilane precursor was used for the deposition of films with a thickness of 100-500 nm.
The chemical compositions of the coatings were determined by means of X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy. The morphologies of the coating systems were studied by means of scanning electron microscopy.
The performance of the coating systems has been studied in different specific tests of corrosion and processing behaviour. The investigated coating systems show a corrosion resistance comparable to reference samples of electro-galvanized steel sheet with additional organic coating even with a coating thickness less of half of the reference samples.

Keywords
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organosilicon thin films
zinc alloy coatings
plasma-enhanced chemical vapour deposition
strip hollow cathode