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**PVD ALD multilayer coatings for corrosion protection of steel**

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The corrosion protection of Physical Vapor Deposited (PVD) coatings has been limited due to typical defects in these coatings. Recently, Atomic Layer Deposition (ALD) has been applied to shield the defects resulting into significantly improved corrosion protection. In this paper we report on the corrosion properties of plasma pre-treated  $\text{Al}_2\text{O}_3/\text{TiO}_2$  ALD nanolaminates on CrN PVD coatings deposited on high speed steel. Corrosion properties were evaluated by Linear Sweep Voltammetry (LSV) and by Neutral Salt Spray (NSS). The formation of protective layers in the defect cavities was shown by Focused Ion Beam (FIB) assisted cross section microscopy. Energy Dispersive Spectroscopy (EDS) was used to investigate the elemental composition of the multilayer films. The application of multilayer coatings for dental steel instruments was demonstrated.

The corrosion current density was reduced by two orders of magnitude with multilayer PVD ALD coatings. Compared to using only PVD CrN coating for corrosion protection, applying the ALD nanolaminates to shield PVD defects reduced the corrosion current density by 95 %. Plasma pre-treatment prior to the ALD deposition noticeably improved corrosion protection: the reduction in corrosion current density was only 90 % without plasma pre-treatment. Rockwell indentation and microscope analysis showed significant improvement in the adhesion of ALD coatings with the plasma pre-treatment. Pre-treatment by oxygen plasma and nitrogen/hydrogen plasma were shown to give identical improvement in both corrosion protection and adhesion.

**Keywords**

ALD nanolaminates

Corrosion resistant coatings

Multilayer films

PVD

Plasma surface cleaning