Title: Depth Profiling of Galvanoaluminium–Nickel Coatings on Steel by UV- and VIS-LIBS

Author: T.O. Nagy U. Pacher A. Giesriegl M.J.J. Weimerskirch W. Kautek

PII: S0169-4332(16)32776-3
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2016.12.059
Reference: APSUSC 34606

To appear in: *APSUSC*

Received date: 30-6-2016
Revised date: 15-11-2016
Accepted date: 8-12-2016

Please cite this article as: T.O. Nagy, U. Pacher, A. Giesriegl, M.J.J. Weimerskirch, W. Kautek, Depth Profiling of GalvanoaluminiumndashNickel Coatings on Steel by UV- and VIS-LIBS, *<![CDATA[Applied Surface Science]]>* (2016), http://dx.doi.org/10.1016/j.apsusc.2016.12.059

Depth Profiling of Galvanoaluminium–Nickel Coatings on Steel by UV- and VIS-LIBS

Nagy, T. O.[1], Pacher, U., Giesriegl, A., Weimerskirch, M. J. J., Kautek, W.

Universität Wien, Institut für Physikalische Chemie
Währinger Str. 42, 1090 Wien

Abstract

Laser-induced depth profiling was applied to the investigation of galvanised steel sheets as a typical modern multi-layer coating system for environmental corrosion protection. The samples were ablated stepwise by the use of two different wavelengths of a frequency-converted Nd:YAG-laser, 266 nm and 532 nm, with a pulse duration of $\tau = 4$ ns at fluences ranging from $F = 50 - 250$ J·cm^{-2}. The emission light of the resulting plasma was analysed as a function of both penetration depth and elemental spectrum in terms of linear correlation analysis. Elemental depth profiles were calculated and compared to EDX-cross sections of the cut sample. A proven mathematical algorithm designed for the reconstruction of layer structures from distorted emission traces caused by the Gaussian ablation profile can even resolve thin intermediate layers in terms of depth and thickness. The obtained results were compared to a purely thermally controlled ablation model. Thereby light-plasma coupling is suggested to be a possible cause of deviations in the ablation behaviour of Al. The average ablation rate h as a function of fluence F for Ni ranges from 1–3.5 µm/pulse for $\lambda = 266$ nm as well as for $\lambda = 532$ nm. In contrast, the range of h for Al differs from 2–4 µm/pulse for $\lambda = 532$ nm and 4–8 µm/pulse for $\lambda = 266$ nm in the exact same fluence range on the exact same sample.

Keywords: LIBS stratigraphy; galvanic coatings; ablation rate; plasma shielding; light-plasma-interaction; depth profiling

[1]Correspondence: tristan.nagy@univie.ac.at