Effect of cerium salt concentration on corrosion protection of hybrid organic/ inorganic Si/Zr sol-gel coating on hot dip galvanized steel

T. T. Nguyen[1,2], T. T. Thai[2], A. T. Trinh[2], M. -G. Olivier[1]

1 Material Science Department, University of Mons, Place du Parc 20, 7000 Mons, Belgium, email: thithao.NGUYEN@umons.ac.be

2 Institute for Tropical Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam.

Since the early 1990s, the use of chromate conversion coating to protect hot-dip galvanized (HDG) steel from corrosion has been restricted due to its high toxicity to humans and the environment. Therefore, many approaches have been carried out to find a new alternative free-chromate coating for corrosion protection of HDG steel.

Recently, the hybrid sol-gel based on tetraethylorthosilicate (TEOS), 3-glycidoxypropyltrimethoxysilane (GPTMS), and zirconium propoxide (ZTP) showed excellent protection for aluminum and its alloys. The sol-gel layer is a promising alternative to replace chromate conversion coating [1]. Besides, the incorporated cerium salt in the sol-gel coatings enhanced the corrosion resistance [2]. Therefore, this work aims at studying the corrosion protection of hybrid sol-gel Si/Zr (based on TEOS, GPTMS, ZTP) doped with different cerium salt contents to protect HDG steel from corrosion. The protective properties of sol-gel coating undoped and doped with various cerium salt concentrations were examined by electrochemical measurement (electrochemical impedance spectroscopy, EIS) versus immersion time in the chloride medium 0.1 M NaCl, salt spray, and adhesion test.

The EIS results proved that the cerium salt content affected the protective behavior of the sol-gel coating. Moreover, the sol-gel doped with 650 ppm cerium salt exhibited the optimized barrier properties for HDG steel, providing an improvement and durable protection for long term. Meanwhile, for higher or lower cerium salt contents, the barrier effect of the modified coating presented faster deterioration. Furthermore, the salt spray and adhesion tests indicated that the presence of cerium salt decreased the delamination and reinforced the adhesion of the sol-gel film.

References:

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