

Silane organic-inorganic thin film as tie layer for excellent adhesion between galvanized steel surface and UV curable organic coating

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Surface functionalization of Zn via unsaturated silane chemistry has been explored in order to improve interfacial adhesion between Zn and a UV curable polymer coating. Adhesion inadequacy in UV curable polymer coatings is more pronounced in applications where the surface profile of the metal, i.e. roughness, cannot be altered. Ultra-fast curing of these coatings, while being their main advantage in high pace production environments, does not allow ideal alignment of electrostatic charges in the polymer matrix against the surface charges on metal thus producing a weak electrostatic bond at the interface. In the present study a vinyl terminated silane has been deposited on the galvanized steel surface as a thin film with a few nanometres thickness via sol-gel route to achieve strong bond between Al native oxide and silanol groups. This functionalizes the metal surface with unsaturated C=C group that participate in subsequent radical polymerisation process with the UV curable polymer coating upon exposure to UV light. Adhesion measurement by mechanical (dry) and electrochemical (wet) methods indicate significant improvement in bonding that in turn enhances anti-corrosion properties. The silane layer was analysed by measuring surface free energy and elemental analysis and a physical model has been advanced to explain the bridging mechanism between Zn surface and UV curable polymer coating via the silane chemistry. Electrochemical corrosion testing has also been performed to evaluate the effect of surface treatment on protective properties of coating.