SELF-HEALING COATINGS BASED ON ELECTROCHEMICAL POTENTIAL TRIGGERED RELEASE SYSTEMS

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ABSTRACT

For economical and ecological reasons corrosion protection of metals by functional coatings is an important research field in the chemical, steel and automotive industries. The first « self-healing » coatings were based on cancerogenic Cr(VI) compounds which are stepwise being abolished. This development initiated the introduction of alternative concepts regarding autonomous self-healing coatings to protect metals from corrosion once the coating is damaged and bare metal is exposed. The metal should be protected by intelligent release of corrosion inhibiting molecules and also of polymerization agents from micro- or nano-storage containers inside the coating. Until now the majority of concepts presented in this field are based on the release of the self-healing agents by mechanical damage of the coating, by pH-change inside the defect, by the change of ionic strength or a combination of these triggers.

Here we introduce a self-healing coating concept which can be used generally for any kind of metal. The release of self-healing agents in our concept is triggered by the change of the electrode potential at the defect site which is for all metals decreasing by several hundred millivolts in case of corrosion, while the change of pH and other triggers is usually different for different metals. Hence, potential is the best trigger [1-2].

The synthesis of suitable potential-sensitive nano-carriers, based on semi-conducting polymers and other redox-sensitive shell materials, and the mechanism of release of self-healing agents were investigated in depth to gain fundamental understanding of the coating system. The coating was applied and tested on iron as well as on zinc and the performance of the coating was investigated by advanced electrochemical techniques with local resolution, such as the Scanning-Kelvin-Probe (SKP).

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