Uncovering intelligent self-healing coating: Synthesis strategies, performance, and evaluation techniques – A review

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Abstract

Extrinsic intelligent-healing corrosion protective coatings have granted significant interest for their sensitivity to environmental stimuli to prevent damage by releasing corrosion inhibitors and polymerizable agents from micro/nanocarriers. Several micro/nanoencapsulation synthesis technologies have been adopted to improve the loading capacity and regulate the releasing behaviour of the healing agents. This context aims to review recent advances in intelligent-healing corrosion protective coatings based on micro/nanocarriers. This review also provides insights for synthesizing strategies and methods of such carriers. The study comprehends further development of extrinsic self-healing coatings by evaluating the advantages and drawbacks of different healing systems. Furthermore, the study includes other corrosion rate evaluation techniques to understand better how to monitor such phenomena.

Keywords: *physical barrier, corrosion resistance, coating, nanoencapsulation, inhibitors*.

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1. Corrosion Coating: from a physical barrier to intelligent protection

Metal corrosion, or as it is known as (Electro) chemical corrosion, is a common phenomenon associated with the degradation of metallic structures. The phenomenon is considered a significant threat to industries and the environment, causing gradual degradation and continual damage to metallic facilities infrastructures [1], poisoning and reduction of shelf-life in canned food industries [2], and other health and economical damages [3]. The industrial operating loss due to corrosion worldwide had increased from 2012, out of which 34.7% were attributed to utility service providers, including gas, water, electricity and telecommunications [4]. Furthermore, the number is increasing up to date. The concept of corrosion is related to the chemical degradation of metallic materials that involve heterogeneous redox reactions at the environment-metal interface [5]. In the environment, the metal-air interface is coated with thin stable metal oxide layers; usually, this layer in the