Multifunctional materials and structures for self-healing applications

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Abstract

The possibility of producing materials able to **perform different functions** and **respond to external stimuli** will undoubtedly be an extremely important research area for the foreseeable future. These new materials will play a crucial role, for example in additive manufacturing, since they will be designed and structured to perform specific operations and adapt autonomously to external conditions and variables, without the need for additional devices. These so-called '**intelligent'** materials meet application demands of multi-functionality and adaptability, dramatically reducing the complexity of systems and making solutions simpler to implement. This consequently renders materials the enabler for many expected developments, promoting creativity and innovation across many different fields.

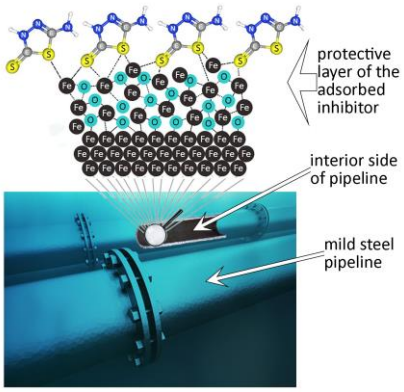

Figure 1. Corrosion protection of mild steel [1].

Multifunctional Material Systems approach the concept of ideality by being more autonomous and polyvalent than their counterpart monofunctionals. A multifunctional material system should **integrate in itself the functions** of two or more different components and/or composites/materials/structures increasing the total system's efficiency (Figure 1).

The purpose of this study is to present the **design**, **development** and **validation** of **multifunctional material** systems that can perform functions in several fields of applications such as Corrosion protective Coatings [1-4], Antifouling coatings, Concrete [5], Shipping, Aviation, Automotive industry and Drug delivery. The technology description of these materials comprises the categories of Core-shell materials, Hollow containers, Mesoporous spheres and Layered Double Hydroxides. These materials were fabricated via combination of **sol-gel technique** together with **radical polymerization**. Furthermore, the synthesis, application and characterization of **intrinsic self-healing coatings** for corrosion protection of metal alloys is described (Figure 2). The protective and self-healing ability of intact and scribed coatings as well as their **responsiveness** and their ability to **restore** their anticorrosion properties after thermal treatment are studied.

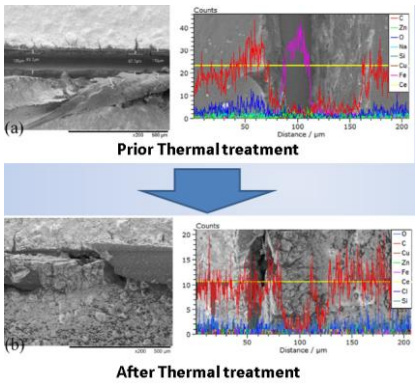

Figure 2. SEM surface images and line elemental analysis of the scribed coatings [3].

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