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# Highly ordered mesoporous silica and halloysite nanotubes loaded with diethylenetriamine DETA for smart anti corrosion coatings

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The development of nanoscience and technology has devoted significant attention to conducting studies on hollow particles. Among the available materials, mesoporous silica nanoparticles have recently gained attention as potential nanocontainers due to their high stability, large surface area, controllable pore diameter and easy surface functionalization as they can store and release organic or inorganic molecules of different sizes and functionalities. The aim of this work is to study the use of mesoporous silica as a potential reservoir for corrosion inhibitor for active corrosion protection of carbon steel and using epoxy encapsulated halloysite nanotubes for the self healing process of the epoxy based coatings. The synthesized mesoporous silica particles were characterized by using XRD, FTIR and SEM. Mesoporous silica particles loaded with diethylenetriamine (DETA) were embedded into the epoxy polymer along with the halloysite nanotubes (HNTs) encapsulated with epoxy monomer and amine immobilized in mesoporous silica with a weight ratio of 5 wt% of mesoporous silica. Kinetics of release of corrosion inhibitor was evaluated by electrochemical impedance (EIS) measurements in 3.5 wt% NaCl solution. The EIS analysis confirms that the release of inhibitor during the corrosion process has significantly improved the anticorrosion properties when compared to the epoxy coated sample without any corrosion inhibitor. The self healing phenomenon in the scratched epoxy coated sample was monitored by SEM during different time intervals. The SEM results showed that that the epoxy pre-polymer was slowly released into the crack.



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Upon release, the epoxy pre-polymer came into contact with the amine immobilized in mesoporous silica and cross-linked to heal the scratch over the sample surface. This study suggests that these novel coatings may have some potential applications in the oil and gas industry.

Keywords: Mesoporous silica, halloysite nanotubes, corrosion inhibitor, Diethylenetriamine, Electro impedance spectroscopy (EIS)