SL 29

STIMULI-RESPONSIVE SELF-HEALING COATINGS UTILIZING A TWO-PART MICROCAPSULE APPROACH

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Incorporation of stimuli-responsive polymer colloids into coatings is an emerging field for industrial application. Polymeric coatings are subject to fatigue over their lifetime caused by a variety of conditions related to both environmental and in-service factors. Among these are applied stresses, thermal cycling, abrasion and scratching. Among the problems associated with fatigue is the formation of microvoids within the coating. If matured into an unchecked microcrack they could cause coating failure or, for example, expose the underlying substrate to a corrosive environment. Self-healing capability thus finds a promising application in anti-corrosion coatings.

Conventional approaches to healing of coating defects, such as heating or solvent treatment, require external input where more contemporary approaches employ smart-functionality within the coating that responds autonomously to defect formation. Our approach employs a two-component microcapsule system embedded within an epoxy host coating matrix. The focus of this talk will be on the design and production of each of these types of capsules, one epoxide based and the other amine based, for an anti-corrosion epoxy coating. The waterborne polymerization process for the encapsulation of the amine component is the heart of the discussion. The material properties and size of the respective capsules, containing similar epoxy and hardener reactive materials to the host coating, are designed so as to be able to survive the curing of the host coating and only to discharge their payload on being cleaved by a microcrack. The epoxide and hardener cores are also designed to have appropriate viscosity and reactivity to be able to diffuse from the capsules to fully fill the microcrack volume and then to mix, react and crosslink so as to enable healing of the host coating. The development of a novel testing technique for the efficacy and kinetics of healing the coating matrix, after rupture of the capsules, will also be discussed.