Multiscale Smart Coatings with Sustained Anticorrosive Action

Summary

Intellectual merit: Sustained protection of materials from chemical and biological degradation (corrosion) and mechanical destruction would have tremendous economic and social benefits. We will pursue this goal by designing composite coatings that release anticorrosion self-healing agents upon demand in response to a defined trigger. This multimodal protection strategy will be based on encapsulation of chemical agents in non-toxic capsules with on-demand activation, designed to suppress degradation processes in open defects and halting crack propagation with early intervention. The integrity requirements of thin coating layers demand sophisticated design of 50 nm -10 μm micro/nano containers, the focus of our efforts.

An interdisciplinary team of chemists, engineers, and microbiologists will redesign manufacturing processes of protective coatings with the addition of active nano/micro containers based on abundant natural components.

Preliminary results indicate that nano/micro container coatings improve mechanical strength and chemical protection to allow operations in extreme conditions (like deepwater work).

Broader impacts: In G8 nations over $700 Billion are expended annually for corrosion damage and protection, often using environmentally-unfriendly techniques (Cr, Sn, Co coatings). In this project, responding to the societal request, “green” long-lasting protective technology based on biocompatible smart materials will be developed. Use of responsive composites doped with natural clay tubes, mesoporous ceramics, and polymeric shells will facilitate sustainable, environmentally-friendly coating systems, unprecedented for nanotechnology.

Collaboration between world leaders in advanced composite materials from Germany, USA and Japan with a young research team from Russia (including Tatarstan, the advanced petrochemical region) creates a dynamic, synergistic cooperation with unrivaled infrastructure.