

Special Issue on New Approaches to Life Prediction

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The purpose of the Research Topical Symposia (RTS) is to bring together corrosion researchers and practitioners, through invited talks from leading experts in topical areas. The 2022 RTS was focused on corrosion life prediction methods used in diverse industries. Most of the talks have been assembled in this Special Issue. The underlying theme of the special issue is the integration of mechanistic insights, experimental data, and field performance into probabilistic methods. Although such approaches can be found in many articles published in *CORROSION* journal, the intent of the Special Issue is to highlight the topic and spur further research and application.

The article by Srinivasan, et al., is an example of coupling microscopic study of the relationship between pit morphology and the type of aerosol salt deposition on stainless steels. The pit morphology can affect the pit to crack transition and has implications to life prediction of stainless steel components exposed to coastal atmospheres, such as spent nuclear fuel storage casks. Rebak provides a perspective on new developments in accident tolerant fuels to mitigate risks of catastrophic reactions of fuel/cladding under extreme scenarios and enable more sustainable operation of nuclear fission reactors.

Wang and Chen discuss life prediction of buried oil and gas pipelines subject to stress corrosion cracking (SCC), specifically focusing on early-stage crack growth. They point to the role played by strain fluctuations and low-temperature creep in the early stages of crack extension. While most of the discussion is on deterministic modeling of crack growth process, they identify stochastic elements of crack coalescence. Ramgopal, et al., discuss the hydrogen embrittlement (HE) of precipitation hardenable Ni-based alloys in offshore oil and gas production systems. They describe the roles of crack-tip strain rate, deformation mode, and crack-tip chemistry on HE. An interesting aspect of their article is the possible connection between molecular level modeling of water adsorption at the crack tip and the effect of applied potential on HE in seawater. Harris, et al., examined the environmentally assisted cracking (EAC) of a high-strength martensitic steel coupled to Ti-6Al-4V bolting material and different metallic coatings to simulate a bearing/gear application in aerospace service. An important aspect of the article is the combination of finite element analysis of the potential distribution due to the galvanic coupling of steel to Ti alloy with fracture mechanics-based prediction of EAC. Such coupling can help simulate complex geometries of service components, while maintaining veracity to mechanisms of EAC.

Sagues and Alexander introduce a new damage prediction model for reinforced concrete. This approach recognizes that the initiation and propagation stages of damage are coupled through the coupling of potential within the extended concrete structure. The coupling of potential can occur between different regions of a reinforced concrete system that are at different stages of damage. The coupled potential model predicts a slower progress of damage. The authors point to the need to further examine the sensitivity of the model prediction with assumptions of activation volume. Best and Gelling provide a historical review of life prediction of organic coatings and the uncertainties attendant upon field application of coatings. They describe the disconnect between life prediction based on controlled laboratory testing and performance in the field as well as identify probabilistic methods to address the various sources of uncertainty in field conditions. Sridhar describes a Bayesian network approach to integrating diverse sources of data and mechanistic models for predicting seawater corrosion of passive alloys. The challenges attending this approach are described.

Corrosion life prediction is a vast area of study and each application has its own peculiar circumstances that influence performance of the materials, components, and system. A comprehensive coverage of the entire field is well beyond the scope any one publication. However, it is hoped that this special issue will provide the readers a snapshot of the diversity of approaches that have been used and inspire further research.