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COUPLED MODELS FOR ENVIRONMENTALLY ASSISTED DAMAGE

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ABSTRACT

Environmentally assisted damage occurs due to the adverse effects of mechanical loading and harsh environments on susceptible materials. The combined effect of mechanical loading and an aggressive environment reduces the degradation resistance of materials, leading to crack initiation and premature failure, which can result in catastrophic events. Localized corrosion, stress corrosion cracking, and hydrogen embrittlement are widely recognized as ones of the most common material degradation phenomena. They are labeled as complex and often hard to assess destructive failure mechanisms of metallic engineering components in a wide range of industries.

Nowadays, computational modeling is considered an effective method for assessing the degradation resistance of engineering materials and a powerful tool for designing engineering components to prevent catastrophic failures. With the recent advancement in computational power, new multiphysics models and hybrid digital methods for assessing environmentally assisted damage have been developed. These approaches track the evolution of the material-environment interface and account for the synergetic action between the environment and mechanical loading in driving the material degradation, overcoming the long-standing obstacle of simulating environmentally assisted damage especially at the different interacting time scales. These advancements in coupled models have opened the door for naturally capturing, for example, pit-to-crack transition and crack propagation in arbitrary domains.

This session will feature talks and discussions related to environmentally assisted damage (pure fatigue is excluded) and will showcase state-of-the-art models for simulating a variety of damage mechanisms. Topics covered will include localized corrosion, stress corrosion cracking, and hydrogen embrittlement. The session will cover recent developments and consist of presentations from renowned experts in the field.