PERIDYNAMIC MODELING OF STRESS CORROSION CRACKING

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Stress corrosion cracking (SCC) is a particular type of corrosion mechanism, which occurs only for specific materials subjected to specific loadings and operating under specific environmental conditions. SCC affects structures operating in a wide range of fields. A better understanding of SCC may improve the performance and safety of structures as well as effectiveness and cost of maintenance plans. Numerical simulations can be useful for this purpose as a good complement to experimental studies. A newly developed computational methodology, peridynamics, can be used to simulate SCC. Peridynamics is a generalization of classical continuum mechanics theory and its formulation does not break down in presence of discontinuities such as cracks. Various studies have revealed the capability of peridynamics in capturing complex phenomena such as crack nucleation, branching, coalition of multiple cracks and crack arrest. There is no need for external crack growth criteria or external equations for treating interfaces. Moreover, peridynamics is also suitable for investigating multiscale and multiphysics problems.

In this presentation, the applicability of peridynamics for modelling stress corrosion cracking will be demonstrated. Different cathodic and anodic mechanisms can lead to SCC. In this study, only a particular type of cathodic mechanism called enhanced impurity decohesion is considered. The same peridynamic numerical framework is used to predict the hydrogen diffusion process along grain boundaries which allows capturing the consequent material strength degradation.