

Title: Predicting Localized Corrosion in the Presence of Ionizing Radiation

Abstract:

Canada is increasing its reliance on nuclear energy to produce the ever-growing demand for energy. The nuclear industry uses a variety of metals that must maintain their chemical and physical properties in the presence of ionizing radiation for many decades (or some time period). Two of these metals are copper and carbon steel. Neither of these metals are traditionally thought to undergo localized corrosion, which is where material damage is concentrated in a small area across a bulk surface. However, in the presence of radiation, this localized damage is commonly observed causing concern that material failure may present faster than in conditions without localized damage.

Establishing a mechanism of irradiation-induced localized corrosion has proven complex due to synergies between many radiation effects. Radiation can induced structural changes in the metal via point defects while simultaneously changing the chemistry of the solution via radiolytic decomposition of water. How the radiation-induced structural and solution changes, individually and combined, lead to material damage is not straightforward. My group investigates radiation-induced corrosion mechanisms of individual and combined radiation processes using traditional electrochemistry and scanning probe microscopy techniques (e.g., scanning electrochemical cell microscopy, SECCM) in combination with the SLOWPOKE-2 nuclear reactor at RMC to irradiate materials.

In this talk, optimization of SECCM for measuring localized corrosion will be discussed. The use of the SLOWPOKE-2 nuclear reactor at RMC for irradiating materials will be illustrated while discussing methods of decoupling structural and chemical effects of material damage. Specifically, radiation-induced hydrogen absorption is investigated as a cause of increased material damage.

Bio:

Dr. L. Grandy is an Assistant Professor in Chemistry and the Manager of the SLOWPOKE-2 nuclear reactor at the Royal Military College of Canada. She is an expert in corrosion and radiation-induced chemistry, with a strong background in electrochemical and surface analytical techniques. Her research program at RMC involves determining the role of radiolysis species on the corrosion of metals relevant to the nuclear industry using multi-scale electrochemical techniques. As the manager of the research reactor, she is involved in projects such as for neutron activation analysis, medical isotopes production, and radiation contamination testing.