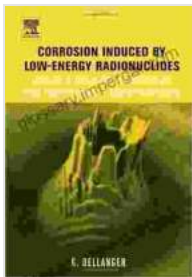


Corrosion Induced by Low Energy Radionuclides

The management of nuclear waste, particularly spent nuclear fuel, poses a significant challenge due to its potential for prolonged radioactivity and the associated risk of corrosion. Low energy radionuclides (LERs), such as uranium-238 and thorium-232, play a crucial role in the corrosion processes of nuclear materials.



Corrosion Induced by Low-Energy Radionuclides: Modeling of Tritium and Its Radiolytic and Decay Products Formed in Nuclear Installations by Gilbert Bellanger

★★★★★ 5 out of 5
Language : English
File size : 10655 KB
Text-to-Speech: Enabled
Print length : 700 pages



This comprehensive guide delves into the mechanisms and consequences of LER-induced corrosion, providing invaluable insights for researchers, engineers, and policymakers involved in nuclear waste management.

Mechanisms of LER-Induced Corrosion

Alpha Radiation Effects

Alpha particles emitted by LERs interact with the material's surface, releasing energy that can displace atoms and create defects in the crystal

lattice. These defects provide pathways for corrosion to initiate and propagate.

Beta Radiation Effects

Beta particles from LERs penetrate deeper into the material, causing excitation and ionization of atoms. The resultant energy dissipation can lead to chemical reactions and the formation of corrosive species.

Gamma Radiation Effects

Gamma radiation, with its high energy, can penetrate the material deeply and interact with the atomic nuclei. These interactions can produce secondary electrons, which in turn contribute to the formation of defects and the initiation of corrosion.

Consequences of LER-Induced Corrosion



a) Photo of a standard container with surrogate waste (Broome et al, 2016)



b) Schematic of a 6-inch Pipe Overpack Container (modified from Porter (2013))

- **Material Degradation:** LER-induced corrosion can degrade the mechanical properties of nuclear waste containers and other components, reducing their containment capacity.
- **Radionuclide Release:** Corrosion can create pathways for the release of radioactive materials into the environment, posing risks to human health and ecosystems.
- **Hydrogen Embrittlement:** Hydrogen produced during LER-induced corrosion can diffuse into the material, causing embrittlement and increasing the risk of failure.

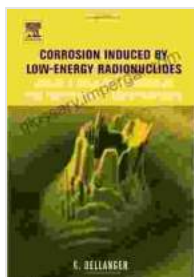
Mitigation Strategies

Developing effective mitigation strategies is essential to prevent or minimize LER-induced corrosion. Several approaches have been explored:

- **Corrosion-Resistant Materials:** Using materials with inherent corrosion resistance, such as stainless steels and titanium alloys, can enhance the durability of nuclear waste containers.
- **Corrosion Inhibitors:** Introducing corrosion inhibitors into the waste package can slow down or prevent corrosion reactions.
- **Sacrificial Anodes:** Attaching sacrificial anodes to the waste container can provide cathodic protection, reducing the risk of corrosion.
- **Waste Form Optimization:** Modifying the physical and chemical characteristics of the nuclear waste to reduce its corrosivity can improve the long-term stability of the waste package.

LER-induced corrosion is a complex and challenging aspect of nuclear waste management. Understanding the mechanisms and consequences of this corrosion is essential for developing effective mitigation strategies and ensuring the safe and long-term storage of radioactive waste.

This guide provides a comprehensive overview of LER-induced corrosion, empowering researchers, engineers, and policymakers to address this critical issue and contribute to the safe management of nuclear waste.



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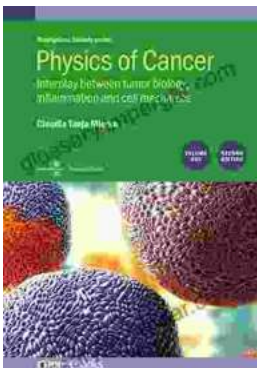
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