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Editorial: Nuclear materials degradation

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Editorial on the Research Topic
Nuclear materials degradation

Nuclear energy is regarded as one of the most efficient ways to reduce global carbon emissions, especially in China, which has made a promise to the world. Safety is the prerequisite in the development of a nuclear power plant (NPP). However, during the operation of an NPP, degradation of materials occurs and severely threatens the safety of the operation. As a result, to ensure the long-term safety of an NPP, it is of great importance to understand the degradation behavior of key materials, which is essential for nuclear safety management and indispensable for life prediction.

The aim of this Research Topic is to provide a communication platform for researchers from all over the world who are working on nuclear material degradation. Nuclear materials include both metallic and non-metallic materials used in reactors (e.g., PWR, BWR, and fast reactors). The degradation here refers to corrosion, stress corrosion cracking, fretting wear, corrosion fatigue, galvanic corrosion, flow accelerated corrosion, and other types of failure modes (Ming et al., 2019; Ming et al., 2020; Okonkwo et al., 2021; Wu et al., 2021; Wu et al., 2022; Zhang et al., 2022; Zhang et al., 2023). Both experimental and simulating methods are suitable. Additionally, high-level nuclear waste disposal and other related issues are in the scope of this Research Topic. With the effort of the Guest Editor team, the Editorial Development Manager's great support, and the participants' valuable contributions, this Research Topic has successfully published five high-quality peer-reviewed papers.

The article entitled "The kinetics of hydrogen peroxide reduction on rare Earth doped UO_2 and SIMFUEL" by Zhu et al. investigated the electrochemical reduction of hydrogen peroxide in sodium chloride solutions containing various anions (bicarbonate/carbonate and sulphate) on Gd-UO_2, Dy-UO_2, and a SIMFUEL (UO_2 doped to simulate spent nuclear fuel). A faster reaction was found on the SIMFUEL surface, and bicarbonate/carbonate, but not sulphate, was found to suppress peroxide reduction. In addition, the noble metal particles present in the SIMFUEL appeared to play only a minor role in the reduction process.

The article entitled "Novel photocatalytic coating for corrosion mitigation in 304LSS of dry storage canisters" by Sathasivam et al. developed a multilayered titanium dioxide (TiO_2) composite coating on 304 L stainless steel (a candidate canister material for storing the spent radioactive fuels of an NPP) and studied its corrosion behavior in aerated 3.5% NaCl solutions. They found that the Ce-doped TiO_2 coating exhibited a better performance in terms of photocathodic protection than the coating without cerium doping.

A Review by Zhang et al. summarized the research progress on the corrosive environment large-scale evolution for nuclear waste containers. Typical corrosion environments, focusing on the temperature, saturation, oxygen content, and radiation obtained by numerical simulation under different deep geological conditions in various countries, are presented.

Shu et al. reviewed the degradation behavior of the fuel cladding material 20Cr25NiNb for the British Advanced Gas Reactor (AGR), focusing on the long-term in-core service degradation (oxidation, carbon deposition, high-temperature creep, thermal aging, and mechanical property degradation) and the intergranular stress corrosion cracking and intergranular attack behavior during the wet storage of spent fuel.

Zhang et al. reviewed the hydrogen solubility, hydrogen diffusion coefficient, hydrogen absorption, and embrittlement behavior of two types of potential alloys, carbon steel and titanium (or its alloys), which were used as the container material of nuclear waste for deep geological disposal.

We hope the five papers in this Research Topic can provide useful information, new insight, data support, and a safety assessment of nuclear materials for readers.

Author contributions

Writing—original draft preparation, HM; writing—review and editing, ZZ, JC, and JN. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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