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Special Issue Reprint

Radiation Damage in Materials

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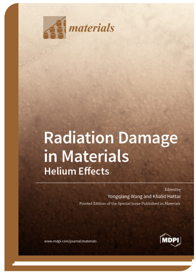
Edited by
Yongqiang Wang
Khalid Hattar



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The complexity of radiation damage effects in materials that are used in various irradiation environments stems from the fundamental particle–solid interactions and the subsequent damage recovery dynamics after the collision cascades, which involves multiple length and time scales. Adding to this complexity are the transmuted impurities that are unavoidable from accompanying nuclear processes. Helium is one such impurity that plays an important and unique role in controlling the microstructure and properties of materials used in fast fission reactors, plasma-facing and structural materials in fusion devices, spallation neutron target designs, actinides, tritium-containing materials, and nuclear waste. Their ultra-low solubility in virtually all solids forces He atoms to self-precipitate into small bubbles that become nucleation sites for further void growth under radiation-induced vacancy supersaturations, resulting in material swelling and high-temperature He embrittlement, as well as surface blistering under low-energy and high-flux He bombardment. This Special Issue, "Radiation Damage in Materials—Helium Effects", contains review articles and full-length papers on new irradiation material research activities and novel material ideas using experimental and/or modeling approaches. These studies elucidate the interactions of helium with various extreme environments and tailored nanostructures, as well as their impact on microstructural evolution and material properties.