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Hydrogen and tritium in various materials irradiated in STIP

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Among the PIE results of samples irradiated in STIP, the results of hydrogen and its isotopes release measurements are very interesting but less understood. Unlike helium, the actual hydrogen concentration of an irradiated specimen cannot be well predicted without measurement, as it strongly depends on the irradiation temperature and the irradiation environment of the specimens. In most cases, the hydrogen concentration measured by melting specimens is either very low (< 20%) or very high (few times) as compared to the calculated values. Comprehensive TDS analysis was performed on alloys SS 316, F82H, zircaloys-2 and AlMg3 as well as pure metals such as Al, Ti, Fe, Ni, Cu, Nb, Ta, Au and Pd in the temperature range of 40-1250 ℃ at Pacific Northwest National Laboratory (PNNL, USA). Gas species detected included atomic masses 2 to 6, including the hydrogen species H2, HD, HT, DT, D2 and T2, and the helium isotopes 3He and 4He. Some interesting trends were observed. For example, in the case of steel specimens, the main hydrogen release peak occurred a lower temperature and was narrower for lower dose (~10 dpa) specimens as compared to higher dose (~20 dpa) specimens. Significant deuterium and tritium releases were found for all specimens, ranging from ~17% to ~30%, and from ~2% to ~9% of the total hydrogen content, respectively. Recently tritium release experiments were performed at PSI and the results showed a good agreement with those obtained at PNNL. In this presentation, the experimental results achieved so far are summarized and compared with calculated values. The trapping mechanisms of hydrogen in various materials are briefly discussed.

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