Corrosion of Carbon and Stainless Steels in H_2O-sCO_2 Environments for Power Cycle Applications

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Abstract

The corrosion behaviors of carbon and stainless steels were investigated in supercritical CO_2 (sCO_2) containing H_2O and O_2 simulating conditions that exist in direct sCO_2 power cycle heat exchangers. Thermodynamic properties of CO_2-H_2O-O_2 systems related to the corrosion phenomena was determined using NIST software. The exposure tests of the corrosion samples were performed at a pressure of 80 bar and two temperatures, 50 °C and 250 °C up to 1500 hours. The samples were exposed to H_2O-containing CO_2 and sCO_2-containing H_2O both with and without O_2.

The corrosion tendency of the alloys was compared using mass change measurements. The surface microstructure and composition of the corrosion films were investigated using X-ray diffraction and scanning electron microscopy. The overall results indicate that the corrosion mechanism for each material in H_2O containing sCO_2 is different from the mechanism in sCO_2 containing H_2O and that the mechanisms for corrosion are different with the introduction of O_2.

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