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Activation energy for parabolic corrosion kinetics of Zircaloy-4 by consecutive hydrogen measurement at 30 – 80°C

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On the issue related on a safe disposal of spent fuel claddings is the corrosion and the subsequent gas and radionuclides release. The Zircaloy corrosion under a prospected disposal condition has recently been investigated by sensitive hydrogen measurements at 30°C, and reported that the kinetics in the rate around nm/y follows the parabolic rate law.

In the present work, an improved equipment to be usable even at higher temperatures up to 80°C has been applied for measuring hydrogen gas generated from Zircaloy-4 corrosion for 90 days. The Arrhenius relation of the parabolic rate constants for the corrosion kinetics has showed the activation energy of 84.4 ± 8.4 kJ/mol, the value of which is lower than that for the general pre-transition corrosion under the in-pile temperature above 260°C (i.e. 113-135 kJ/mol), suggesting that simple mass transfer through a thin and firm oxide film is limiting the low temperature corrosion of Zircaloy.

Summary

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