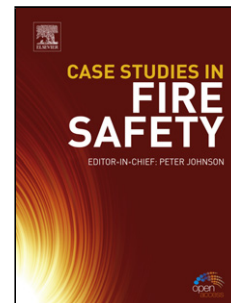


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In-situ electrochemical impedance spectroscopy measurements of zirconium alloy oxide conductivity: relationship to hydrogen pickup

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Highlights:

- In-situ electrochemistry experiments of zirconium alloys in 360°C pure water.
- Oxide resistivity varies as function of time and there is a linear relationship between oxide resistivity and instantaneous hydrogen pickup fraction.
- The resistivity of the oxide layer formed on Zircaloy-4 is higher than on Zr-2.5Nb, resulting in a higher hydrogen pickup fraction of Zircaloy-4, compared to Zr-2.5Nb.

1. Introduction and motivation

1.1. Introduction

Hydrogen pick-up during nuclear fuel cladding corrosion is a critical life-limiting degradation mechanism for nuclear fuel in existing and advanced nuclear reactors. Indeed, hydrogen ingress can cause cladding embrittlement by brittle hydride precipitation in the zirconium metal, and limit cladding lifetime [1]. Although it is understood that different alloys exhibit not only different corrosion kinetics, but also different hydrogen pickup rates at different stages of corrosion [2-5], a complete understanding of the role of alloying elements in the corrosion and hydrogen pick-up mechanisms is still lacking. It is also known that the corrosion performance of zirconium alloys worsens as the alloy purity increases and almost any alloying addition (even in very small proportions)

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