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Influence of kinetic effects on terminal solid solubility of hydrogen in zirconium alloys

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Abstract

The integrity of irradiated zirconium based nuclear fuel cladding is related to the precipitation of hydrides which is closely connected with the solubility of hydrogen. A review on the development of measurement technologies is given and the resulting terminal solid solubilities are reflected with respect to the established model of hydrogen solubility in zirconium alloys. The results often allow for a different interpretation than the established model. An alternative qualitative approach is proposed in which the fixed TSSp for the precipitation of zirconium hydrides is replaced by a kinetic model based on thermal history, total hydrogen content and the cooling rate. The influence of the modification of the model from a fixed TSSp to a kinetically limited TSSd is discussed with respect to the understanding of hydride embrittlement processes in long term storage.

Keywords: Hydrides, Zirconium, Terminal Solid Solubility, Spent Nuclear Fuel, Embrittlement

1. Introduction

A major prerequisite for the dry cask storage of spent nuclear fuel (SNF) is the exclusion of systematic cladding failure. The latter potentially influences storage, transport and necessary steps for the subsequent transfer of the SNF

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