MICROSTRUCTURAL CHANGES IN OXIDIZED Zr-2.5%Nb ALLOY BY THERMAL TRANSIENTS

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Abstract. *The experimental simulation of LOCA scenarios in CANDU reactors assumes transients of temperature on the pressure tubes from fuel channels. In case of a postulated accident of this kind, which is supposed to occur after some hot years in normal operating conditions, the safety analysis should take into account the oxidised state of pressure tube and the changes of its microstructure during the ramps temperature as well. This paper investigates the micro-structural changes in oxide layers and material base (Zr-2.5%Nb) resulted from specific thermal transients. This study was realised on Zr-2.5%Nb alloy samples, which were previously isothermally oxidized at temperature of 700^{o}C for different time intervals. Afterwards, the resulted samples with variables thickness oxide layers were subjected to the various temperature transients at different heating/cooling rates. The oxidation process in steam was carried out in a thermobalance facility. Using the thermo gravimetric analysis (TGA) module it is possible to make in-situ measurements of weight gain. The isothermal oxidized samples were heated and cooled in thermobalance furnace at different controlled rates. Subsequently, the oxidized Zr-2.5%Nb samples were investigated by: optical microscopy, scanning electron microscopy (SEM) and EDS (energy dispersive X-ray spectrometry). The paper presents some results of experimental investigations, mainly focused on the oxide layers and changes of alloy microstructures*.

Keywords: oxidation, oxide, Zr-2.5%Nb samples, X-ray spectrometry, oxide layers, alloy microstructures

1. Introduction

Pressurized Heavy Water Reactor (PHWR) uses zirconium base alloys due to their low neutron absorption cross-section, low irradiation creep and high corrosion resistance in operating reactor conditions. Zr-2.5%wtNb alloy, used for pressure tubes from fuel channels, has replaced Zircaloy-2 due to better physical and mechanical properties. The temperature of coolant fluid from pressure tubes inside varies from 260^{o} C (inlet) to 310^{o} C (outlet) and its pressure is in 9 to 11 MPa range. Manufacture processes suppose thermal treatments and a highly anisotropic hexagonal close packed (HCP) microstructure is obtained as fabricated.

In analysis of loss-of cooling accident (LOCA) the requirement is to maintain the integrity of pressure tube, a third barrier for gas fission products released. During

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