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Coincidence Doppler broadening study of Eurofer 97 irradiated in spallation environment

V. Sabelová^{A,B}, V. Kršjak^B, J. Kuriplach^C, Y. Dai^B, V. Slugeň^A

^AInstitute of Nuclear and Physical Engineering,

Faculty of Electrical Engineering and Information Technology,

Slovak University of Technology in Bratislava, Ilkovičova 3, 81219 Bratislava, Slovakia

^BLaboratory for Nuclear Materials, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland

^CDepartment of Low Temperature Physics, Faculty of Mathematics and Physics,

Charles University in Prague, V Holešovičkách 2, 18000 Prague 8, Czech Republic

veronika.sabelova@stuba.sk

Abstract: The behaviour of transmutation helium during isochronal annealing of irradiated Eurofer 97 was investigated using coincidence Doppler broadening spectroscopy (CDBS). The investigated ferritic martensitic steel was irradiated in 2000 and 2001 in the frame of the STIP-II project at the Swiss neutron spallation source (SINQ) (irradiation with neutrons and protons) at the Paul Scherrer Institute (PSI).

During isochronal annealing experiment, coarsening of vacancy clusters and/or growth of helium bubbles was observed at $T \geq 500$ °C. This process causes an increase of low-momentum annihilation events and related increase of the S parameter during thermal treatment of material. On the other hand, the maximum concentration of helium in small vacancy clusters (V_n) was observed after annealing at 400 °C, where an excellent correlation with the calculated CDBS profiles of $V_n + He_m$ clusters was found.

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1. Introduction

Severe displacement damage in structural materials in the future nuclear facilities can be aggravated by nuclear transmutation that converts a small part of existing alloying elements to impurities. Transmutation impurities, particularly helium and hydrogen may have a substantial impact on the degradation of material properties. Helium embrittlement is a big challenge for the R&D of materials designed for fusion and spallation

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