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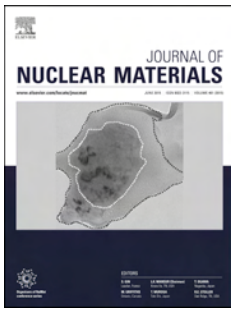

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PII: S0022-3115(17)31643-4

DOI: 10.1016/j.jnucmat.2018.02.031

Reference: NUMA 50804

To appear in: *Journal of Nuclear Materials*

Received Date: 25 November 2017

Revised Date: 23 January 2018

Accepted Date: 20 February 2018

Please cite this article as: Y. Miao, J. Harp, K. Mo, Y.S. Kim, S. Zhu, A.M. Yacout, Microstructure investigations of U_3Si_2 implanted by high-energy Xe ions at 600°C, *Journal of Nuclear Materials* (2018), doi: 10.1016/j.jnucmat.2018.02.031.

Microstructure Investigations of U_3Si_2 Implanted by High-Energy Xe Ions at 600°C

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Abstract

The microstructure investigations on a high-energy Xe-implanted U_3Si_2 pellet were performed. The promising accident tolerant fuel (ATF) candidate, U_3Si_2, was irradiated by 84 MeV Xe ions at 600°C at Argonne Tandem Linac Accelerator System (ATLAS). The characterizations of the Xe implanted sample were conducted using advanced transmission electron microscopy (TEM) techniques. An oxidation layer was observed on the sample surface after irradiation under the $\sim 10^{-5}$ Pa vacuum. The study on the oxidation layer not only unveils the readily oxidation behavior of U_3Si_2 under high-temperature irradiation conditions, but also develops an understanding of its oxidation mechanism. Intragranular Xe bubbles with bimodal size distribution were observed within the Xe deposition region of the sample induced by 84 MeV Xe ion implantation. At the irradiation temperature of 600 °C, the gaseous swelling strain contributed by intragranular bubbles was found to be insignificant, indicating an acceptable fission gas behavior of U_3Si_2 as a light water reactor (LWR) fuel operating at such a temperature.

Keywords: U_3Si_2, fission gas behavior, ion irradiation, light water reactor (LWR), microstructure characterization, accident tolerant fuel

1. Introduction

The East Japan Great Earthquake and Tsunami and the subsequent nuclear accident in Fukushima Daiichi Nuclear Power Plant motivated global efforts in searching for novel fuel-cladding solutions

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