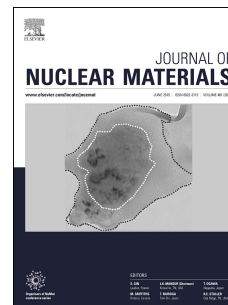


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Study of a “hot” particle with a matrix of U-bearing metallic Zr: clue to supercriticality during the Chernobyl nuclear accident

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Abstract

This paper is dedicated to the 30th anniversary of the severe nuclear accident that occurred at the Chernobyl NPP on 26 April 1986. A detailed study on a Chernobyl “hot” particle collected from contaminated soil was performed. Optical and electron microscopy, as well as quantitative x-ray microbeam analysis methods were used to determine the properties of the sample. The results show that the particle ($\approx 240 \times 165 \mu\text{m}$) consists of a metallic Zr matrix containing 2–3 wt. % U and bearing veins of an U,Nb admixture. The metallic Zr matrix contains two phases with different amounts of O with the atomic proportions $(\text{U,Zr,Nb})_{0.73}\text{O}_{0.27}$ and $(\text{U,Zr,Nb})_{0.61}\text{O}_{0.39}$. The results confirm the interaction between UO_2 fuel and zircaloy cladding in the reactor core. To explain the process of formation of the particle, its properties are compared to laboratory experiments. Because of the metallic nature of the particle it is concluded that it must have formed during a very

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