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Mathematical Simulation of the Growth of the Interaction Layer Between UMo Fuels Dispersed in Aluminium and Other Metallic Matrices

N – Materials for Nuclear Power Generation

The problem of the formation of the interaction layer between the fuel uranium-molybdenum and the matrix aluminium are one of the main concerns in the technology of the fabrication and irradiation of high denisty-low enriched uranium dispersion fuels. To face this problem and to enable the comissioning as soon as possible of this fuels, formation and growth of the interaction layer between the fuel and matrix have being studied theoretically and experimentally for a few years, and one of the most important conclusions is for the use of some elements, added in the fuel or matrix phase, in order to act as a diffusion inhibitor.

In this work are presented the results of the simulation of the growth of the interaction layer between fuel and matrix, over a well stated theoretical mathematical model, based mainly on the diffusion theory. The data obtained were coupled with several experimental results of DTA / TG performe over a variety of UMo and UMo-X alloys , relating to the reactions fuel+matrix, composed mainly by uranium-molybdenum and uranium-molybdenum-X plus aluminium. A set of equations was defined to predict the behavior of the interaction layer as a funtion of several parameters, mainly those ocurring in the fabrication and irradiation of the fuel plates. The results were compared with the parameters obtained for the UMo systems as related previously in literature.

Alloys of UMo and UMo-X were prepared with additons of 5 to 10% weight molybdenum and with a maximum of 2 % weight of the X element. Curves of mass variation as a function of temperature in well defined thermal treatment cycles were obtained both experimentally in a TG / DTA equipment and also theoretically, and the results were compared. This comparision was also performed with the data existent in the literature. It is our aim to understand the role of the elements in the growth or inhibition of this undesired reaction and to validate the model, in order to contribute to the researches in this particular area of the dispersion-fuel fabrication technology, in order to help the RERTR program in their efforts to reduce the enrichment of research reactors nuclear fuels.