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REACTIVE SPARK PLASMA SINTERING OF UAl_2 + Al POWDER MIXTURES

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ABSTRACT

Targets for ^{99}Mo production are usually manufactured by the picture-frame method. Most of them contain a mixture of uranium aluminides (UAl_2 , UAl_3 , UAl_4), called UAl_x , dispersed in an Al matrix. UAl_2 is often chosen as the starting aluminide. During the manufacturing process, and especially the hot working, interdiffusion phenomena occur between the UAl_2 particles and the surrounding Al matrix, leading to the formation of the UAl_3 and/or UAl_4 phases. As UAl_2 compound does not dissolve well in alkaline solutions commonly used for the extraction of ^{99}Mo , its quantity must be minimized in the final product. This requires up to 7 hours at 813 K [1].

In the present study, UAl_2 + Al powder mixtures were compacted by a spark plasma sintering (SPS) process (SPS), on the basis of a previous work on the fabrication of U_3Si_2 + Al dispersed fuel mini-plates by this method [2]. Different temperatures (from 800 to 850 K) and sintering times (from 0 to 15 min) were investigated. The progress of the interaction reactions was monitored by X-ray diffraction (XRD) and scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS). Only a few minutes were sufficient to convert the UAl_2 phase into an UAl_3 + UAl_4 mixture, as it will be illustrated by the results of these characterizations. This preliminary investigation supports SPS as an alternative method for the assembly of composite irradiation targets.

References:

- [1]. G.L.C.R. Contorbia *et al.*, *Phase quantification in UAl_x -Al dispersion targets for Mo-99 production*, Journal of Nuclear Materials 509 (2018) 465-477.
- [2]. J. Havette *et al.*, *Short communication: Spark plasma sintering as an innovative process for nuclear fuel plate manufacturing*, Journal of Nuclear Materials 543 (2021) 152541.