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Metallographic Preparation of Uranium-Molybdenum

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ABSTRACT

In the framework of the joint international efforts to reduce the risk of proliferation by minimizing the use of highly enriched uranium, a new research reactor fuel based on uranium-molybdenum (UMo) alloys is being developed. During this development, numerous metallurgical investigations of fuel behavior are necessary. A fundamental element of this investigation is a clear preparation technique without artefacts which enables an analysis of the microstructure.

Generally, the sample preparation process can be divided in four steps, namely sample extraction, embedding, grinding and polishing and finally etching. Depending on the goal of the investigation and the applied analysis methods different procedures are necessary in each step to yield an optimal result. A systematic investigation of available preparation methods and tools was carried out to determine the ideal procedures for unirradiated bulk UMo alloy samples.

A modified microstructure with artefacts, such as scratches on the surface, edge rounding or smearing caused by inapplicable preparation steps increases the risk of a wrong interpretation. For this reason, during the whole preparation sequence, emphasis was put on avoiding the appearance of seemingly false microstructures caused by mechanical, thermal or chemical effects. The grain structure of UMo is uncovered in all relevant phases as well as possible dendrites. Individually selected etching procedures increase the contrast of the revealed structures. The developed recipes are suitable to prepare UMo alloy samples for analysis via optical microscopy, SEM, EDX and EBSD.