

FABRICATION TECHNOLOGY OF HIGH URANIUM LOADED DISPERSION FUEL ELEMENTS

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The pool type fuel for research and radioisotope production reactors, as IEA-R1 reactor of IPEN, is fabricated by mechanical assembling of fuel plates which have meats formed by dispersions of U_3O_8 fuel particles (or other uranium compound such as U_3Si_2) in an aluminum matrix. The adopted method to fabricate fuel plates, also called picture-frame technique, involves the rolling of an assembling set composed by two external aluminum cladding plates, one internal aluminum frame plate and one fuel meat fabricated through powder metallurgy technique, which contains fuel particles dispersed in an aluminum matrix, according to (FIG.1). During fuel meats fabrication, it's important to ensure homogeneity of fuel particles dispersion in the aluminum matrix. On the other hand, the rolling process introduces fragmentation of the brittle U_3O_8 particles and porosity formation. Specifications for the particle size distribution of the raw fuel powder were developed based on theoretical considerations related to ideal dispersions and fuel stability under irradiation. This work aims at evaluating the dispersion homogeneity of the fuel meat, as well as the evolution of volumetric distribution of fuel particle size and pore structure (texturization) in the rolled fuel meat after each roll pass. These fuel features strongly determine the fuel performance under irradiation. This work has been carried out for microstructural characterization of fuel meats, based on both optical densitometry and quantitative optical microscopy. (FIG.2) presents a typical result obtained from a fuel plate after the last roll pass. It is possible to analyze the U particle size distribution and porosity distribution, and the results allow the determination of optimum powder size distribution that would result in a specific particle size distribution after rolling with characteristics closer to an ideal dispersion. This method has demonstrated to be suitable to characterize the U_3O_8 particles distribution inside the fuel meat.



FIGURE 1 - Assembling set used to fabricate fuel plates involving the so-called picture-frame technique.

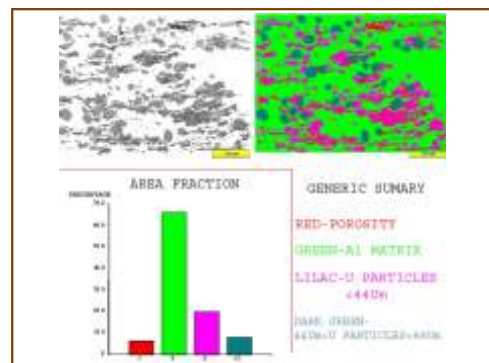


FIGURE 2 - Typical Phase % Curve with U_3Si_2 particles, porosity sites and aluminum matrix.