ACTIVITIES ON FUSION OF U_3SI_2 (20%U235 ENRICHED) AND POWDER FABRICATION

Saliba-Silva, A.M.; Martins, I.C.; Oliveira, E.T.; Pereira, J.V.; Durazzo, M.

Centro do Combustível Nuclear - IPEN/CNEN-SP

Keywords: U3Si2; nuclear fuel; uranium silicide.

Since 2000, The Nuclear Fuel Center of IPEN has been dedicating great efforts to achieve expertise in production of the intermetallic alloy U_3Si_2. Finally, in 2004, the Special Alloys Laboratory (SA-Lab/CCN) has arrived to the full experimental route to produce in fabrication scale the necessary alloy for nuclear fuel. As the nuclear program at IPEN foresees an increasing production for radioisotopes, IPEN's reactor IEA-R1m should perform its operational routine using up to 5MW power. This activity is due to the high demand for radiopharmaceuticals used in nuclear medicine in Brazil. Nevertheless, this process consumes bigger amount of fuel than the previous practice with 2 MW. Besides that, the routine of the reactor will operate up to 120 operational hours/week. For this, it is necessary to increase the meat concentration of fuel plate. It was decided to produce the fuel based on U_3Si_2, which has an international well established practice for research reactor fuel at the requested meat concentration (FIG.1). The uranium silicide can be safely handled and processed to reach the required concentration in the meat. Researches have already shown that it can reach, in technological terms, up to 4.8gU/cm^3. The worldwide practice to produce U_3Si_2 is based on metallic uranium routine. The metallic uranium has already been achieved its full possibility of been processed in SA-Lab/IPEN since 2003. From the produced uranium dingot, we remelt the metal inside an induction furnace with silicon addition, with an adequate vacuum instrumentation and facilities for handling and refining uranium and uranium alloys. The zirconia crucible was specially designed to reach temperatures higher than 1750ºC and to coupe with the aggressive environment created by uranium attack on linings. The load arrangement inside the crucible was deeply studied to help the sequence of melting in the several stages that molten alloy passes before reaching the final intermetallic composition (FIG.2). More than 20 trials were carried out using deployed uranium before the first LEU U_3Si_2 were made in a successfully way. It was produced 3 enriched U_3Si_2 meltings in 2004 in order to form the first load for fuel plate element fabrication using our own produced material. In general terms, the quality of this intermetallic has fully accomplished the needs for its high requested quality to be used as a nuclear material. The X-ray difractogram (FIG.3) attests the phases presents in the produced power of this alloy.

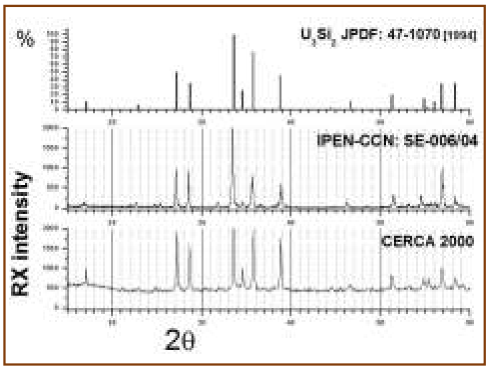

FIGURE 1 - X-ray Difractogram showing the U_3Si_2 produced by IPEN (SE-005/04), contrasted to JPDF standard lines and imported (CERCA) the already used powder.

FIGURE 2 - Assembling of U_3Si_2 crucible load before melting and the resulting ingot after induction melting.

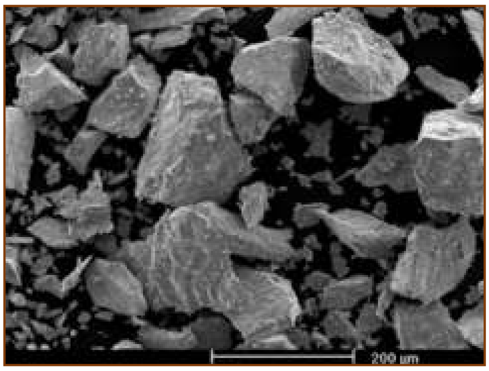

FIGURE 3 - SEM of 20% enriched U_3Si_2 powder.