SESSION III

Fuels for Transmutation Devices

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Papers presented **6**

Nitride Fuel and Pyrochemical Process Developments for Transmutation of Minor Actinides in JAERI
M. Akabori et al. (JAERI, Japan)

The Preliminary Performance Analysis of the Transmutation Fuel for Hyper
B-O. Lee et al. (KAERI, KOREA)

Characterisation of Actinide Alloys as Nuclear Transmutation Fuels
J.R. Kennedy et al. (ANL, USA)

Design Concepts and Process Analysis for Transmuter Fuel Manufacturing
G.F. Mauer (UNLV, USA)

Uranium Free Nitride Fuel Modelling, Fabrication, Characterisation and Irradiation
J. Wallenius (Royal Institute of Technology, Sweden)

Plutonium and Neptunium Conversion Using Modified Direct Denitration
L.K. Felker et al. (ORNL, USA)

Session summary

A number of presentations in this session have shown how important it is to consider all aspects relevant for the P&T scheme. The fuels will of course contain significant amounts of MAs and thus remote handling will be necessary, especially because P&T is based on a multirecycling scenario. It can be further assumed that an automation of the various processes involved contributes to reduce costs significantly.

The work carried out in the department of mechanical engineering at the UNLV on 3-D simulation helps to design processes under normal operation and incident (e.g. collisions at pin filling) conditions. The development applies for various types (composition and geometry) of fuels, e.g. dispersion fuels, ceramic fuels and metallic fuels in form of pellets or as dispersion fuel.

Another important issue is the link between separation (partitioning) and fuel fabrication and also in this case this conversion process will be of course necessary for any material recycling step.

The plutonium and neptunium conversion process developed at ORNL is using a modified direct denitration. In direct denitration a low-surface-area glassy product is obtained, therefore an additive is mixed with the uranyl nitrate solution to produce an oxide with desired ceramic properties comparable to oxide obtained by the ammonium diuranate (ADU) process. In fact it is important for the design of an efficient conversion process to obtain products, which are ready for fuel fabrication and at the same time to minimize any losses of actinides because this the prerequisite of an efficient P&T scenario (cf. also the article in the local newspaper, where it was claimed that P&T could make a deep underground waste disposal such as YUCCA MOUNTAIN redundant). It is planned to include in the near future all actinides.

The EC program CONFIRM dealing with the development of U free nitride fuels for application in ADS is a milestone in the P&T scenario development. Nitride fuels offer a promising potential in P&T scenarios and they were selected as a candidate fuel in the new EUROTRANS project. Carbo-thermic nitridation of PuO_2 and ZrO_2 powders is used for fabrication of (Pu,Zr)N; oxygen levels < 0.2 weigh % and pellet densities = 82% TD were achieved with this method. The thermal diffusivity and heat capacity of (Pu0.25,Zr0.75)N pellets were measured by CEA at Cadarache and pellets remained stable at T = 2 340 K under 1 bar of nitrogen.

The infiltration method developed at ITU is applied for the fabrication of (Am,Zr)N.

Am volatility during sintering is a key parameter to minimize losses and results show that a nitrogen atmosphere is much better in this respect if compared to an inert gas atmosphere. Problems related to the fuel reactivity need further investigation, but it could be shown here again, that nitrogen in the filling gas reduces the Am vapor pressure in the fuel pin.

Good quality fuels could be prepared and 4 (Pu, Zr)N pins were fabricated at PSI and send to Studsvik for irradiation in December 2003. In October 2004 Studsvik withdraw from the project and negotiations have started with NRG Petten to take over irradiation. If this transfer can be realized, a destructive PIE of irradiated CONFIRM pins will be included in the EUROTRANS project.

An other irradiation of sodium bonded (Pu,Am,Zr)N pins is scheduled to start in PHENIX in 2006 in the frame of the FUTURIX (DOE-CEA-ITU-JAERI collaboration) project. High temperature stability tests of (Pu,Zr)N will be made by the Bochvar Institute in Moscow and thermo-mechanical modelling of (Pu,Am,Zr)N irradiation in He, Na and Pb-Bi bonded pins, as well as for VIPAC are to be made by IPPE in Obninsk (MATINÉ project). All these activities underline the international interest in these new fuel materials.