Preparation and Characterization of \((\text{U}_{0.47}\text{Pu}_{0.53})\text{O}_2\) Microspheres for Test Pin Irradiation in FBTR

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Conventionally ceramic nuclear fuels are prepared in the form of cylindrical pellets by ‘powder-pellet’ route having several process steps e.g., milling, granulation, power compaction, etc. and is associated with radiotoxic dust hazard. On the other hand Sol-Gel process, being a wet chemical route, is dust-free, minimizes the problems of radioactive aerosols and is ideally suited to remote and automated manufacturing of highly radiotoxic plutonium and \(^{233}\text{U}\) bearing mixed oxide fuels.

Vibro-compacted sphere-pac fuel pin is one of the methods for loading sol-gel derived fuel particles in a clad tube. The fuel is in the form of small spheres, normally in two or three different size fractions. Apart from the advantages during fabrication, sphere-pac fuel has exhibited comparable if not better performance during irradiation. In view of various positive aspects associated with sol-gel derived sphere-pac fuel and need of our own irradiation data, the task force on sol-gel vibro compaction technology, comprising scientists from BARC and IGCAR, has proposed to irradiate a capsule containing two sphere-pac pins and a reference pin with solid pellets in FBTR for 300 h. MOX fuel microspheres of 780 \(\mu\)m size containing 53 % \(\text{PuO}_2\) prepared at BARC and natural \(\text{UO}_2\) microspheres of 115 \(\mu\)m size are vibro compacted in the ratio 3:1 to achieve a smear density of 80 % TD. This is to be irradiated initially for 100 h at 205 W/cm and then for 200 h at 260 W/cm peak power.

The internal gelation process, which was originally developed at the KEMA labs Netherlands, was significantly modified to prepare high density MOX microspheres containing such high concentration of Pu for the first time. About 72 g of characterized MOX microspheres were sent to IGCAR for sphere-pac fuel pin fabrication and irradiation.