Micro-Nano hetero structures a game changer in nuclear fuel cycle

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The interaction between the fission products, their out springs and fuel structure determining its thermal stress and structural damage has an important role in limiting the burnup factor.
A novel idea having its origins in the understanding of the complexity of the interaction between the fission products, nuclear recoils and lattice has been developed driving to a novel fuel structure called “cer-liq-mesh”. The new structure uses a liquid to take the fission products radiation damage and optimises the fuel beads dimensions.
This material combination has the advantage of eliminating simultaneously the fission products end or range damage and the thermal expansion cracks by moving the thermal spike power discharge of the fission products outside the bead. The ceramic beads are soaked into a liquid and stabilized mechanically by micro-metal wires bringing a several times increase in thermal conductivity and no fuel thermal stress at operating temperatures. The selection of the immersion liquid gives the buoyancy of the fission products making possible to have them float, as is the case for LBE or sink if NaK is used.
The ceramic beads may contain a nano-heterostructure also immersed into another drain fluid with the role of collecting the transmutation products, and moving outside the structure for further use, may be made in a closed or open micro-nano-flow circuit.
The easy fuel recovery and reuse reduces the need of hazardous chemical reprocessing procedures as Urex making possible that fission products to be easily collected and chemically stabilized and partitioned. These fission products might become a very special and precious ore of the future, if appropriately partitioned and stored. The “cer-liq-mesh” fuel in spite of its initial fabrication complexity is bringing significant improvements in usage and simplifications in waste treatment procedures.
The new fuel is almost equivalent with the actual LEU fuel and may have extended life in near constant reactivity adjusted by fissile-fertile isotopic ratios, being possible of being used in all the actual and future reactor structures from the PWR to travelling reactivity wave reactors.