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Chemistry, crystal chemistry and SPS technology for elaboration of perspective materials for nuclear wastes and minor actinides consolidation

Albina I Orlova and **Vladimir N Chuvildeev**
Nizhny Novgorod State University, Russia

Safety improvement in management of radwaste is an actual problem on the final stage of the nuclear fuel cycle. There are 450 operating nuclear reactors in the world, and 67 more are being built. In the guidelines for the management of highly radioactive waste, developed by IAEA for countries-participants, a special place is given to ceramic materials based on inorganic compounds of oxide and salt character. Ceramics are recommended with a variety of structural forms, about 30 crystal modifications. Nature similarity as a key principle of technological advances of the 21st century, including of course the materials sciences, is used by us as the base for development of mineral-like materials for nuclear technology. The report presents our data on the structural-chemical modeling of various phases of different complexity of chemical compositions with the structures of minerals kosnarite, langbeinite, monazite, whitlokite, chlorapatite, pollucite, fluorite, garnet; their synthesis in the form of nano-powders and almost non-porous ceramics and also the results of stability studies. The prepared compounds were characterized by XRD, DSC, IR methods and were tested under heating, radiation and in aqueous systems. It was confirmed the formation of com-pounds with the proposed structures. The temperature regions of their existence were established. The results of leaching and irradiation with accelerated Xe-ions are presented. To improve stability and therefore enhance the ecological safety barrier in the storage and disposal of radwaste, we apply Spark Plasma Sintering (SPS) method to synthesize the ceramics. This technology provides a ceramic sintering within 3 to 12 minutes, with a density close to theoretical value. Small duration of sintering of nuclear materials is a significant factor in reducing the risk of release of radio-nuclides to environment.

Biography

Albina I Orlova is working in the field of New Inorganic Materials used in Nuclear Chemistry for radwaste immobilization of dangerous isotopes, for actinide transmutation, as well for construction materials. She uses the structure properties and physico-chemical principles for elaboration of new ceramics with mineral-like crystal forms.

albina.orlova@inbox.ru

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