Contribution ID: **4** Type: **Poster**

UO2, NpO2 and PuO2 preparation in aqueous nitrate solutions in the presence of hydrazine hydrate

Tuesday, 13 May 2014 17:15 (1h 30m)

Modern nuclear power engineering is focused on the use of fast neutron reactors (FNR). These reactors run on the mixed uranium-plutonium oxide fuel (MOX) and allow one both to use weapon-grade plutonium as a fuel and to transmute formed long-lived actinide isotopes.
In this connection there arises the problem of a creation of economically effective and environmentally acceptable technology of the MOX fuel production. The separation technologies of U and Pu from spent nuclear fuel (SNF) complete nitrates forms of these elements. As a rule, uranium and plutonium are isolated from the solutions by ammonia and oxalate precipitation, respectively. Isolated compounds are used for the production of powders of uranium and plutonium dioxides or nitrides for MOX fuel synthesis. For example powders of the mixed oxides are produced by precipitation from the solutions of mixtures of ammonium diuranate and plutonium hydroxide or by combined co-precipitation ammonium uranylplutonyl carbonates followed by filtration, drying and ignition of the compounds obtained at 800 ℃ under reducing conditions of argon-hydrogen atmosphere. The disadvantages are obvious - the complexity of the implementation and the multi-stage processes.
The development of new technologies for MOX fuel involves fixing the problem of denitration of actinides aqueous solutions. There exist the methods of direct denitration and by using reagents. Gaseous hydrogen, formaldehyde, formic acid, urea, sugar, ethyl alcohol et al. are used in the methods of reagent denitration.
This work presents data on thermal denitration of U, Np, Pu solutions by hydrazine hydrate to produce individual and mixed oxides of these elements. Simple and effective method of preparation of homogeneously mixed U, Np and Pu dioxides from aqueous nitrate solutions containing a mixture of the actinides was developed. The method is to use a thermal denitration of solutions of U, Np and Pu nitrates in the presence of hydrazine hydrate to obtain hydrated dioxides of these elements. It was established that the UO2xnH2O calcination results:
• crystalline UO2 under inert or reducing conditions in the range of 280-800 ℃;
• UO3 in air atmosphere at 440 ℃;
• U3O8 at 570-800 °C.
It was shown that thermolysis of the solution containing a mixture of uranium, neptunium and plutonium nitrates at 90 ℃ in the presence of hydrazine hydrate allows one to prepare hydrated dioxides (U, Np, Pu)O2xnH2O which on heating to ~300 ℃ transmogrify into crystalline (U, Np, Pu)O2 solid solution.

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Session Classification: Poster Session - Chemistry of Actinide and Trans-actinide Elements

Track Classification: Chemistry of Actinide and Trans-actinide Elements