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Phases relations in the system Ln2(Ti,Zr)2O7 with imitator of the Ln-An fraction

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Complex cubic oxides with a pyrochlore structure (sp. gr. Fm3m) and formulae [8]A2[6]B2O7 are suggested as the most promising host phases for long-lived actinides immobilization. Compositions of co-existed phases in the system: Ln2(Zr2-xTix)O7 ("x" is ranged from 0 to 2 through 0.1) are examined using XRD and SEM/EDS. "Ln" means a mixture of lanthanides with composition 0.26 La + 0.51 Ce + 0.24 Pr + 0.79 Nd + 0.14 Sm + 0.04 Eu + 0.03 Gd. It was used as imitator for Ln-An fraction of liquid high level radioactive wastes from spent nuclear fuel reprocessing. The samples with "x" ranged from 0 to 1 are composed of a single pyrochlore-type phase, while in the ceramics with "x" > 1 two phases (cubic pyrochlore and monoclinic Ti-rich phase) co-exist. These data are compared with former results in the simple system Nd2(Zr2-xTix)O7 [1]. Three groups of criteria for selection of the optimal Ln-actinide waste forms are suggested: crystal-chemical group (isomorphic capacity of the phases and flexibility of their structure), physical-chemical group (corrosion behavior, radiation durability, and mechanical properties) and technological factor (efficiency of industrial-scale fabrication of the matrices). Quantitative estimations of all these parameters are made. The research is supported by the Russian Foundation for Basic Research (project 11-05-12003-ofi-m).

1. Shoup S.S., Bamberger C.E., Tyree J.L., Anovitz L.M. // J. Solid State Chem. 1996 (127) 231.