

## Coprecipitation of Actinides with the Peroxides of other Actinides

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### Introduction

The actinide elements Th, U, Np and Pu all have peroxides and arguments have been given<sup>2,3,4</sup>, that these compounds form two groups, one consisting of the peroxides of thorium and plutonium, which peroxides are very similar in constitution and a second group, the peroxides of uranium and neptunium, also very similar to each other but different from the first group.

We have tried to obtain information concerning this difference between the two groups by means of a series of coprecipitation reactions. The idea was, that elements present in tracer quantities would be likely to be carried very efficiently by a peroxide precipitate of similar constitution and less efficiently by a precipitate of different constitution.

In most cases the tracer activity was sufficiently high that it could be counted directly without interference from the  $\alpha$ -activity of the carrier. However, in the case of the coprecipitation of Np on  $\text{UO}_4$  the Np was isolated from the uranium before the  $\alpha$ -counting by means of Dowex 1-X4. (First the ion exchanger was treated with concentrated HCl, then the mixture of uranium and neptunium was adsorbed on the ion exchanger from concentrated HCl and finally the neptunium eluted with a solution of 6 N HCl + 0.1 N,  $\text{NH}_2\text{OH} \cdot \text{HCl}$ .) Similarly plutonium and thorium were separated by adsorbing both on an ion exchanger from a HCl +  $\text{HNO}_3$  solution followed by stripping of plutonium by means of 0.05 N HCl + 0.002 M  $\text{NH}_2\text{OH} \cdot \text{HCl}$ .

Table 1. Coprecipitation of tracer quantities of actinides with actinide peroxides

Carrier precipitate	Element carried in tracer quantity	Tracer Isotope	Presumed Constitution of the pair of peroxides involved	Fraction of tracer activity coprecipitated
thorium peroxide	neptunium	$\text{Np}^{237}$ *	different	0.99
	plutonium	$\text{Pu}^{239}$	similar	1.00
uranium peroxide	thorium	$\text{Th}^{228}$ (RdTh)	different	0.90
	thorium	$\text{Th}^{234}$ (UX 1)	different	0.78
	neptunium	$\text{Np}^{237}$ **	similar	0.33
	plutonium		different	0.95

\* The neptunium solution was fumed several times with  $\text{H}_2\text{SO}_4 + \text{SO}_2$  to bring the element into the tetravalent state.

\*\* The neptunium solution was treated as in case (1). Coprecipitation with Zr-phenylarsonate indicate that 31% of the neptunium was actually present as  $\text{Np}^{5+}$ .

The results in Table 1 do not show the behaviour to be expected if this argument should be valid. The combinations of elements supposed to give "similar" peroxides, U + Np and Th + Pu give a coprecipitation which is not noticeably better than that of "different" peroxides. If a general conclusion can be given from our results, it is rather that on the whole thorium peroxide is a better carrier for actinides than uranium peroxide, but the differences are not very striking.

### Experimental

Thorium peroxide was precipitated with  $\text{H}_2\text{O}_2$  from a sulphuric acid solution (0.07 N) containing some nitrate, uranium peroxide from a uranyl nitrate solution in nitric acid (0.004 N). Activity measurements were made on small aliquots of the different aqueous fractions after evaporation to dryness under a zinksulphide scintillation counter. (UX1 was measured under a Geiger Müller counter through an aluminium absorber of 54 mg/cm<sup>2</sup>.)

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