Chemical Studies of Rutherfordium (Element 104)*

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Abstracts of three papers on chemical studies of rutherfordium* which have been accepted for publication in Radiochemica Acta are given below:

Part I. Thin Film Ferrocyanide Surfaces for the Study of the Hydrolysis of Rutherfordium.

The chemical properties of element 104, rutherfordium (Rf), and its group 4 homologs were studied by sorption on glass support surfaces coated with cobalt ferrocyanide. The surface studies showed that the hydrolysis trend in the group 4 elements and the pseudogroup 4 element, Th, decreases in the order Rf > Zr ≈ Hf > Th. This unexpected trend was attributed to relativistic effects which predict that Rf^{4+} would be more prone to having a coordination number (CN) of 6 than 8 in aqueous solutions due to a destabilization of the $6d_{5/2}$ shell.

Part II. Solvent Extraction into Tributylphosphate from HBr Solutions.

The chemical properties of element 104, rutherfordium (Rf), and its group 4 homologs and other tetravalent cations were studied by solvent extraction into tributylphosphate (TBP) from various concentrations of HBr and HCl. Since bromide is a larger and softer (more polarizable) anion than chloride, the stability of Rf-bromide complexes was expected to differ from the stability of Rf-chloride complexes, and a comparison of the two systems was undertaken. Our studies showed that the extraction trend decreased in the order Zr>Hf>Rf/Ti for HBr, compared to Zr>Hf>Rf>Ti for HCl, showing that Rf and Ti did not extract as well in either system, probably because they hydrolyzed more easily than Zr and Hf.

Part III. Solvent Extraction into Triisooctylamine from HF Solutions.

The extraction of element 104, rutherfordium (Rf), and its group 4 homologs into 0.25 M triisooctylamine (TIOA) in o,m,p-xylene from various concentrations of hydrofluoric acid was studied. This extraction system was of particular interest because all group 4 cations studied formed complexes with the same coordination number (CN) of 6. Therefore, species extracted were similar and the extractability depends on the radii of the fluoride complexes. The studies showed that the extractability for the group 4 elements in this system decreases in the order Ti>Zr≈Hf>Rf, in inverse order from the decrease in ionic radii Rf>Zr≈Hf>Ti. This order is different than the order in the hydrolysis, TBP-HCl, and TBP-HBr extraction systems where Rf, due to decreasing CN, behaves more similarly to Ti than to Zr and Hf.

Footnotes and References

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