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Developments in extraction studies of Rutherfordium

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During the last several years the extraction behavior of element 104, rutherfordium, has been studied in a variety of chemical systems using various techniques. The goal of these experiments is to obtain information on the chemistry of rutherfordium by studying complex formation between Rf ions and different ligands and comparing it with the lighter homologs, Zr and Hf. Liquid-liquid extraction is used to determine the distribution of a species between two immiscible phases. The amount of metal ion present in each phase can either be measured directly or indirectly, and the resulting distribution ratio can be calculated. The determination of distribution ratios can give valuable information such as stability constants and the number of ligand molecules in the complex. Methods to study the chemical behavior of rutherfordium include manual liquid-liquid extraction as well as experiments using automated extraction chromatography with extractants such as tributyl phosphate and thenoyltrifluoro acetone. More recently the fast automated liquid-liquid extraction system SISAK coupled to the Berkeley Gas-filled Separator (BGS) has been used to study Rf extraction with trioctyl amine and dibutyl phosphoric acid. A brief overview of previous experiments will be given, and the current status of liquid-liquid extraction studies with Rf will be discussed. Results from recent model experiments geared toward the development of novel extraction systems using short-lived isotopes of zirconium and hafnium will be presented. These new systems will be especially useful for chemistry experiments coupled to a pre-separator.

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