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Technetium Waste Forms, the Next Possible Steps.

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Technetium is unique amongst the transition metals in that no stable isotope exists. Technetium-99 is a major fission product of uranium-235 (approx. 7% of yield), is found in radioactive waste from nuclear fuel and can occur due to the production of plutonium. Due to its long half-life ($t_{1/2} = 2.1 \times 10^5$ y) and high mobility through geological formations, the migration of 99Tc is a significant challenge in nuclear waste management (including spent nuclear fuel) and it is a major contributor to the amount of radiation in the biosphere.

Another challenge of Tc is that the stable valence states oxidise further (4+ to 7+) just above 1000°C (dependant on O_2 partial pressure) leading to either melting of the target ceramic waste form or volatilization.

In the past we have synthesised oxides first reported by Muller et al. [1] to gain a better understanding of the crystal structure with the most recent work demonstrating the Tc can exist as 5+ in an oxide. Unfortunately, many have interpreted this work to be an attempt to develop a Tc waste form akin to Synroc. These materials would not perform well in the long term given the total substitution of the A or B cation by Tc.

We will be reviewing the work to date and proposing the next steps in Tc waste forms, considering Tc in nuclear fuel reprocessing, nuclear fuel (high burn up scenarios will be an issue), and Tc associated with the production of 99Mo.

[1}. Muller, O., White, W. B., and Roy, R. (1964). Crystal Chemistry of Some Technetium-Containing Oxides. J. Inorg. Nucl. Chem. 26, 2075–2086. doi:10.1016/0022-1902(64)80152-4