TECHNETIUM: BOON AND BANE – MORE CHEMISTRY IS REQUIRED

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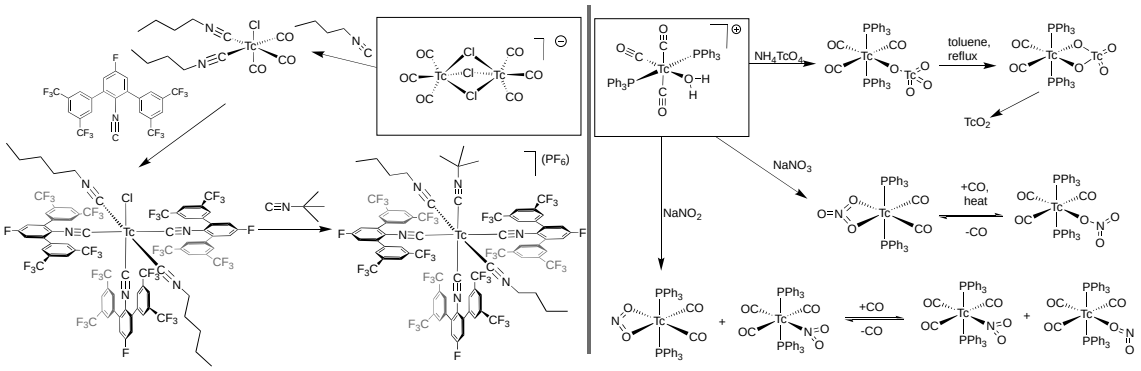
The first man-made element, technetium, has (almost) no natural abundance on earth. Thus, technetium could be regarded as an exotic element without implications for the human society. This, however, is not true, since two technetium nuclides became important during the recent decades: the metastable, γ-emitting nuclear isomer ^{99m}Tc (half-life: 6h) as the workhorse in the diagnostic nuclear medicine and the long-lived, β^--emitting isotope ^{99}Tc (half-life: 200.000 years!!). Nuclear medical applications of ^{99m}Tc have exceeded the number of 40 million annual administrations worldwide and the amount of ^{99}Tc as one of the major fission products of uranium in nuclear reactors is estimated to a minimum of presently 60.000 TBq, which corresponds to approximately one hundred tons of elemental technetium and makes this isotope to one of the most critical nuclides in the nuclear waste treatment.

The development of novel, even more efficient ^{99m}Tc radiopharmaceuticals as well as the search for reliable waste management strategies require extended chemical studies to learn more about the fundamental chemistry of this artificial element. This includes research in the field of organotechnetium chemistry since (1) organometallic ^{99m}Tc approaches are established in routine nuclear medical applications and the related research, and (2) the formation of significant amounts of carbonyl species has also been observed in nuclear waste tanks over a period of some decades.



Two examples of controlled reactions starting from simple technetium carbonyl precursors are described in the Figure illustrate the reactivity of such species with isocyanides (with relevance for pharmaceutical chemistry) [1] and simple inorganic ligands such as nitrite, nitrate or even pertechnetate (with relevance for environmental chemistry) [2]. Both examples may show, that reaction conditions, but also electronic and steric effects allow the control of such reactions as well as the nature of their products.

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[1] Claude, G.; Genz, J.; Weh, D.; Roca Jungfer, M.; Hagenbach, A.; Gembicky, M.; Figueroa, J. S.; Abram, U. *Inorg. Chem.* **2022**, *61* , 16163-16176.

[2] Roca Jungfer, M.; Elsholz, L.; Abram, U. *Inorg. Chem.* **2022**, *61*, 2980-2997.