Rhenium and Technetium: Coordination Chemistry and Radiopharmacy

T. I. A. Gerber*

Department of Chemistry, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

*Author for correspondence e-mail: Thomas.gerber@nmmu.ac.za

The current interest in the coordination chemistry of rhenium and technetium is mainly the result of the application of their $^{186/188}$Re and $^{99m}$Tc radionuclides in radiopharmacy [1]. Due to their position in the Periodic Table (Group 7), these metals display remarkable versatility in their coordination chemistry, with properties of both the early and late transition metals. They also display a variety of structural diversity, with monomers, ligand-bridged dimers/trimers, metal-metal multiple bonded species, and clusters [2].

The ideal radiopharmaceutical would be one that is relatively easy to synthesize, would have stability as well as selective biodistribution \textit{in vivo}, after which it should be able to clear the body with minimal side-effects [3]. In radiotherapy, it is necessary to use radiation that can penetrate the body to the location of the tumor. The use of $^{99m}$Tc complexes as imaging agents has been extremely successful in the past two decades. There has been great success in many regions, including brain, kidney, liver, heart and bone imaging [4]. Rhenium radio-isotopes have a broad spectrum of clinical applications due to its advantageous properties. Both $^{186}$Re- and $^{188}$Re-hydroxyethylidenediphosphonate (HEDP) are radiopharmaceuticals that have been used for the palliation of painful bone metastases in patients [5]. The rhenium radio-isotopes were used to selectively accumulate in the bone by adsorption to the surface of the hydroxyapatite mediated by hydroxide bridges [6].

This presentation will mainly focus on our research in this field during the last decade, illustrating the coordination chemistry of these metals with surprising and unusual coordination complexes in the oxidation states +1 to +6. For example, the monooxo complex [ReO$I$(OEt)(PPh$_3$)$_2$] can be manipulated to give the five-coordinate \textit{cis}-dioxo rhenium(V) complex [ReO$_2$I(PPh$_3$)$_2$], which can easily be converted to the rare rhenium(VI) compound \textit{trans}-[ReO$_2$I$_2$(PPh$_3$)$_2$].

References