VI. 3 Synthesis of Technetium Labeled Complexes by Recoil Implantation

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Inorganic synthesis for new complex compounds has been tried by recoil implantation and related techniques in our laboratory.\(^1\) It is recognized that this type of study is useful to obtain especially complex compounds of technetium of low valence states, which are very difficult or troublesome to be prepared by ordinary reduction and complexing methods starting from per-technetate.

Recoil implantation using a cyclotron for synthesis of technetium compounds was firstly tried by Yoshihara, Wolf and Baumgärtner\(^2\) in KFZ in Karlsruhe, but considerably heavy decomposition of the target system was observed even in chemically stable phthalocyanines. This was caused mainly by heat generated at the event of particle bombardment in the cyclotron, because water cooling for an evacuated quartz tube for the target did not function very well.

In our experiment using Tohoku University Cyclotron, we have bombarded targets in rather simple target arrangement, and this has given unexpectedly successful results. The target assembly is shown in Fig. 1. Powders of metallic molybdenum is mixed with partner complex powders which are suitable for obtaining the aimed technetium complex. The mixture is then pressed into a pellet by application of pressure of about 200 Kg/cm\(^2\). The pellet thus prepared is fairly heat conductive because metallic powder is one of its components, and then is effectively cooled under bombardment. The target is wrapped with an aluminum foil and attached to a basement plate which is set in a holder plate cooled with water from its backside.

A mixture of molybdenum and tris-acetylacetonatochromium(III) was bombarded with 15 MeV deuterons. Nuclear reactions occurring are:

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\begin{align*}
^{98}\text{Mo}(d,n)^{99}\text{Tc} &\quad 6.0 \text{ h} \\
^{96}\text{Mo}(d,2n)^{96}\text{Tc} &\quad 4.3 \text{ d} \\
^{95}\text{Mo}(d,n)^{96}\text{Tc} &\quad \text{*} \\
^{95}\text{Mo}(d,2n)^{95}\text{Tc} &\quad 20 \text{ h} \\
^{94}\text{Mo}(d,n)^{95}\text{Tc} &\quad \text{*} \\
^{52}\text{Cr}(d,2n)^{52}\text{Mn} &\quad 5.7 \text{ d}
\end{align*}
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After bombardment the target was dissolved in benzene, and the solution was extracted with dilute perchloric acid (pH 3), to hold neutral species of technetium and manganese. The aqueous part was passed through a cation exchange column of Sephadex C-25, and various eluants were applied to the
column to eluate technetium and manganese species. The result is shown in Fig. 2. For $^{95}$Tc, the peak at the eluant of HClO$_4$(pH 3) is pertechnetate which is proved to be adsorbed in an anion exchanger, and the peak at the eluant of 0.2 M NaCl + 0.01M HClO$_4$ is unknown chemical species of technetium. In the last part of the elution curve, we obtained $^{52m}$Mn in a cationic form.

To clarify the chemical species in the aqueous part after extraction of irradiated mixture Mo + Cr(acac)$_3$, we applied electrophoresis. The result is shown in Fig. 3. An anionic species is pertechnetate, and a cationic form is considered to be Tc(acac)$_2$aq$^+$ or TcO(acac)$^+$ from the distance of electrophoretic separation.

The similar process using recoil implantation in the mixture Mo + In heddta gave us a Tc heddta complex of Tc(III) which may be useful for neutral and water soluble reagent of technetium. The details will be published in the forthcoming issue of this publication.

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References

Fig. 1. Target arrangement for recoil implantation in mixed power pellet systems.

Fig. 2. Elution curve for the deuteron bombarded mixture Mo + Cr(acac)$_3$ (Once dissolved in benzen, and then extracted with HClO$_4$ of pH 3).

Fig. 3. Electrophoresis of an aqueous part of implanted technetium in Cr(acac)$_3$. 