Reducing waste and time – Novel approach allows for rapid isotope production for medical diagnostics

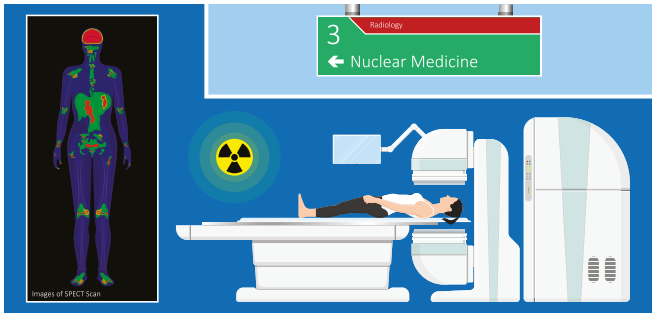
Reference No: B78139

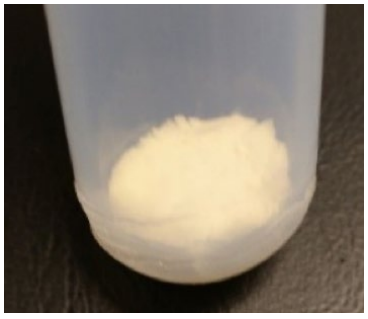
CHALLENGE

With its wide application range in nuclear medicine, **technetium-99m (^{99m}Tc)** is one of the most important medical radioisotopes. Used by doctors and scientists for diagnostic and research purposes into organ structures and function, ^{99m}Tc arises through the ß-decay of its parent isotope molybdenum-99 (^{99}Mo) which is a fission byproduct of the neutron irradiation of targets enriched in uranium-235 (^{235}U) in nuclear reactor. Due to its short half-life of 66 hrs, ^{99}Mo production has to happen on a regular basis and is tightly scheduled to ensure **continuous availability** and not risk interruptions impacting patient care. ^{99m}Tc is directly extracted on-site in hospitals in specialized generators from a decaying sample of ^{99}Mo. By emitting γ-rays, it can then be used for radiodiagnostics after injection into patients. Significant global efforts are underway to ensure a reliable continuous supply chain of ^{99}Mo and ^{99m}Tc. In addition, the call for a more **environmentally friendly solution** has intensified in the last years as the target conversion from highly to low enriched uranium comes at the cost of a significant increase in **radioactive waste.** Following neutron irradiation, uranium targets have to be dissolved to recover and purify ^{99}Mo. Depending on the uranium target used, the dissolution process involves the use of an alkaline or acid solution. In both cases, the **waste management** presents a considerable problem, since the accumulating waste from ^{99}Mo production contains ca. 97% of the enriched uranium from the original targets[1].

INNOVATION

The present innovation describes a dry-chemical process allowing for the rapid separation of molybdenum from uranium by converting them to their corresponding metal hexafluorides. The multi-stage process originates with a gas phase mixture of MoF_6 and UF_6 which is fed into a liquid or supercritical fluid phase to dissolve both metal fluorides. By photoreduction UF_6 is precipitated to its pentafluoride UF_5. Separating UF_5 as a solid phase yields a solution containing the desired MoF_6. The solvent itself is highly volatile, allowing for its evaporation after the separation process. Alternatively, the separation process can be achieved via a gas phase mixture containing MoF_6, UF_6 and a fluorine atom scavenger mixed in gaseous form. The inventive separation has the advantage over the established wet chemical separation by producing smaller quantities of acidic radioactive waste which results in a costly and elaborate disposal.





COMMERCIAL OPPORTUNITIES

- Rapid dry chemical separation of molybdenum and uranium
- Reduced acidic waste production compared to wet chemical procedure
- Opportunity to use separation approach for recycling of unspent uranium from uranium-molybdenum alloys currently under development

DEVELOPMENT STATUS

Proof of concept

REFERENCES:

1 https://www.ncbi.nlm.nih.gov/books/NBK215133/

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PCT filed in 2020

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