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

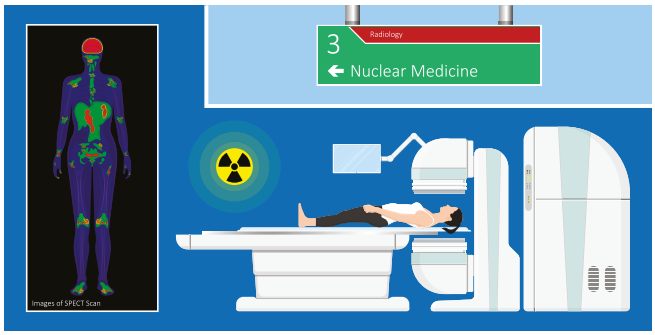
Reference No: B78139

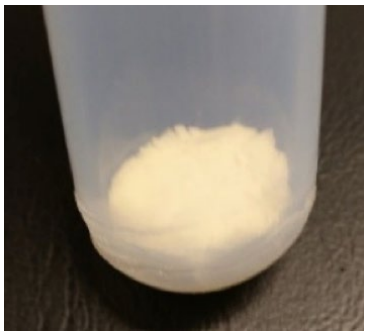
CHALLENGE

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. 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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