LANTHANIDE TARGET FOILS FOR THE EXPLORATION OF TARGETED ALPHA THERAPY PRODUCTION MECHANISMS

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MOTIVATION

▪ Targeted alpha therapy (TAT) is rapidly coming to the frontiers of radiotherapeutic cancer research due to its high cell mortality rate when localized to the cancer site via a targeting agent. While radium-223, actinium-225, and astatine-211 are at the forefront of this research, all of these isotopes require separate isotopes for imaging (theragnostic pairs), since their alpha decays cannot be imaged outside of the body. A lesser known prospect for TAT is terbium-149, which decays via both positron and alpha emission, allowing it to be its own theragnostic pair, and eliminating the need for an imaging analog. However, it does not yet have a well-established production pathway via direct reaction. In order to probe potential reaction mechanisms for its production, a series of experiments will be executed which require the production of isotopically enriched samarium and gadolinium targets.

SAMARIIUM TARGETS

▪ Sm2O3 powder
▪ Low melting point lanthanide
▪ Vapor deposition
▪ 1 mg/cm²
▪ Ta pinhole boat
▪ 3Zr + 2Sm2O3 → 3ZrO2 + 4Sm
▪ Monitor heat of frame
  – < 60°C: metallic
  – > 60°C: oxidized

Aluminum Backed

GADOLINIUM TARGETS

▪ High melting point lanthanide
▪ Electroplating
▪ Convert Gd2O3 powder to GdCl3 with 0.2 M HCl
▪ Evaporated to dryness
▪ Dissolved in 0.01 M HCl
▪ Diluted to 20 mL in EtOH
▪ Voltage: 10, 60, & 200 V
▪ Current: 2 mA
▪ Time: 1 hr
▪ Salt targets produced

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REACTION MECHANISMS

▪ 147Sm(6Li,4n)149Tb
  – 45 MeV
▪ 148Sm(6Li,5n)149Tb
  – 55 MeV
▪ 149Sm(6Li,6n)149Tb
  – 65 MeV
▪ 152Gd(p,4n)149Tb
  – 40 MeV

Self-Supporting

▪ NaCl coated microscope slides, via vapor deposition
▪ Vapor deposition of Sm
▪ Floated Sm off of slide in H2O