A further exploration of the merits of a Niobium/Niobium vs Niobium/Havar target body/foil combination for [^{18}F]Fluoride production: A detailed HP γ-spectrometry study

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In the current nuclear medicine environment, both the Molybdenum crisis and FDA regulation, are driving the PET community to look more closely at the production of [^{18}F]NaF for PET imaging. This situation has led the University of Iowa to design and construct a targetry unit and a synthesis/purification module designed to obtain highest purity [^{18}F]NaF. In this study we investigate the radionuclidic purity of [^{18}F]NaF from this module with [^{18}F]NaF produced from both a Nb/Havar and Nb/Nb target/body combination. The rationale for the targetry comes from the recent observations of the Wisconsin and Edmonton groups[1, 2, 3].

As can be seen from the schematic in Figure 2 [^{18}O]H_2O was irradiated in a Nb target body equipped with either a Nb or Havar front foil. The target water was emptied into a target collection vessel (TCV). Under N_2 overpressure the contents were passed sequentially through a CM cation SPE cartridge and a QMA anion SPE cartridge to an [^{18}O]H_2O recovery vessel. Any non-anionic material was then flushed from the QMA with water (5 mL) to waste. The [^{18}F]NaF and any other anionic species were the eluted into the final product vial with isotonic saline (15 mL).

To assess radionuclidic purity, the Nb/Niobium body/foil combination was bombarded at 30 µA for 5, 10, 20 and 80 minutes. The Nb/Havar body/foil combination was bombarded at 30 µA for 80 minutes. In all cases the TCV, CM, QMA, and Product Vial were quantitatively assessed for radionuclidic content using an GEM20P4-70. ORTEC GEM Coaxial P-type HPGe Gamma-Ray Detector. Results are summarized in Figure 2.

The Nb-Nb body/foil combination spectrum was simple; 30 µA for 10 minutes created minute quantities of ^{56,57,58}Co and ^{52}Mn (<0.1 nCi) from the trace quantities of iron and chromium in the Nb foil, but approximately 1 µCi of ^{93m}Mo from the ^{93}Nb(p,n)^{93m}Mo reaction (Figure 1). The CM cation cartridge quantitatively bound the cobalt isotopes, while the ^{93m}Mo, initially trapped by the QMA anion cartridge, eluted quantitatively with the [^{18}F]NaF. Under similar conditions, the Nb/Havar body/foil created 12 radionuclides at 10-100 nCi levels. The CM/QMA cartridge combination served to eliminate 6 of 12 contaminants, and reduce the quantities of the remaining nuclides substantially, but not completely. The product vial from the Nb/Nb combination had only ^{93m}Mo, while the product vial from the Nb/Havar target resulted in [^{18}F]NaF with ^{51}Cr, ^{95,96}Tc,^{181,182}Re, and ^{93m}Mo (from Nb target body) contaminants with activities ranging from 1-30 nCi.

References:

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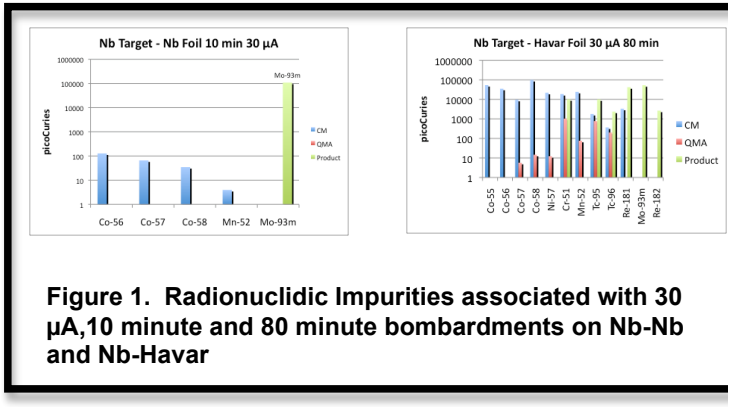

Figure 1. Radionuclidic Impurities associated with 30 µA,10 minute and 80 minute bombardments on Nb-Nb and Nb-Havar

Figure 2. [^{18}F]NaF Synthesis schematic with radionuclidic impurities.