

## PRODUCTION AND PREPARATION OF SN-117M FROM THE BR2 REACTOR

*Bernard Ponsard<sup>a\*</sup>, Jaime Simón<sup>b</sup>, Zech Sandlin<sup>b</sup>, Nigel R. Stevenson<sup>c</sup>*

<sup>a</sup> *SCK•CEN, BR2 Reactor, Boeretang 200, BE-2400, Mol, Belgium;*

<sup>b</sup> *IsoTherapeutics Group, LLC, 1004 S. Velasco St, Angleton, TX, 77515, USA;*

<sup>c</sup> *Serene, LLC, 21 Waterway Avenue, suite 225, The Woodlands, TX, 77380, USA;*

<sup>\*</sup> *Corresponding Author Email Address: [bponsard@sckcen.be](mailto:bponsard@sckcen.be)*

### Introduction

Tin-117m (Sn-117m) is a 14 day half-life theranostic radioisotope emitting 159 keV gamma photons (86%) and low-energy conversion electrons (~140 keV) that deposit their energy within 0.3 mm in tissues. Successful results with this isotope have been achieved for bone pain palliation, the treatment of inflammatory cardiovascular diseases and most recently in the treatment of arthritis by radiosynoviorthesis (radiosynovectomy).

### Reactor production and radiochemical preparation

While very high specific activities (>1,000 Ci/g) can be achieved in accelerators by reactions such as Cd-116( $\alpha,3n$ )Sn-117m or Sb-nat(p,xn)Sn-117m, research reactors are able to produce large quantities of low specific activities suitable for various applications in nuclear medicine by the inelastic scattering reaction Sn-117(n,n' $\gamma$ )Sn-117m. As this reaction is characterized by a threshold of 318 keV, the irradiation positions have been selected in the BR2 High-Flux Reactor providing the highest available fast neutron fluxes above 100 keV of 6.0 e+14 n/cm<sup>2</sup>.s. Several irradiation campaigns of ~93% Sn-117 enriched metal have been successfully performed during single full reactor operating cycles of 21 to 28 days. These were performed inside standard reactor fuel elements loaded in the central irradiation channel H1/center of the reactor core. Specific activities of Sn-117m in the range of 7-9 Ci/g have been achieved at the end of irradiation (EOI). The multi-Ci scale of reactor produced Sn-117m satisfies the demands for clinical trial and commercial uses. Specifically, the product being evaluated to treat arthritis requires a specific activity of 0.5 Ci/g at manufacturing and has a two-week shelf-life. Therefore, at EOI the specific activity of the Sn-117m should be at least 4 Ci/g to allow for several weeks of treatments between irradiation cycles.

The irradiated targets are transported to IsoTherapeutics Group, LLC in TX, USA. At this facility, the tetraiodide form of the irradiated tin material is readily prepared with HI or other reagents. This material becomes the basis of the colloidal radiosynoviorthesis product presently being used in canine osteoarthritis and future human rheumatoid arthritis trials.

### Conclusions

Suitable irradiation conditions have been achieved at the BR2 High-Flux Reactor to produce the requested specific activities of Sn-117m by the inelastic scattering reaction. Radiochemical preparations of Sn-117m with specific activities of up to ~7 Ci/g have been obtained. The quantities and specific activities produced are sufficient to support commercial product demands.

**Keywords:** nuclear medicine, Sn-117m, reactor produced isotopes, high-flux reactor