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Development of target system for production of I-123 in Cyclotron 30

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1. Introduction

Probably the most ‘widely used cyclotron produced radionuclide is 1-123 as the isotope of choice for diagnostic radiopharmaceuticals containing radioiodine. One of the most promising uses of 1-123 is in the imaging of monoclonal antibodies to localize and visualize tumors. This work was mainly focused on the development of target system for production of I-123 in Cyclotron 30. We have analyzed the original I-123 target system which is constructed by company in Canada and designed with solidworks 3D CAD program. We have designed newly by changing cooling method of straight line into spiral line. We look forward to increase the cooling efficiency by decreasing water resistance inside the target chamber. The target system also is made by modular method which is possible to change target quickly. So, the radiation exposure to engineers when exchanging target will be minimized.

2. Methods and Results

For the aim to produce iodine-123 with as little impurity as possible, a new production system via the Xe-124(p,2n)Cs-123 reaction in gaseous target material was developed by using C30 cyclotron at the Korea Institute of Radiological and Medical Sciences (KIRAMS). The production of a radioactive nuclide 123I by irradiation of 30MeV proton can be written as:

$$^{124}Xe(p, 2n)^{123}Cs \rightarrow {}^{123}Xe \rightarrow {}^{123}I$$

The excitation function of the reaction $^{124}Xe(p, 2n)^{123}Cs$ was reported by F. Tarkanyi et al. as shown in Fig. 1[1].

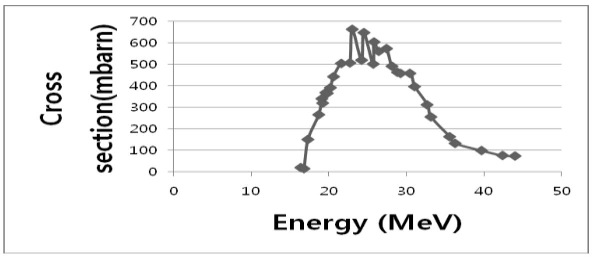

Fig. 1 Experimental exitation function of the reaction $^{124}Xe(p, 2n)^{123}Cs$

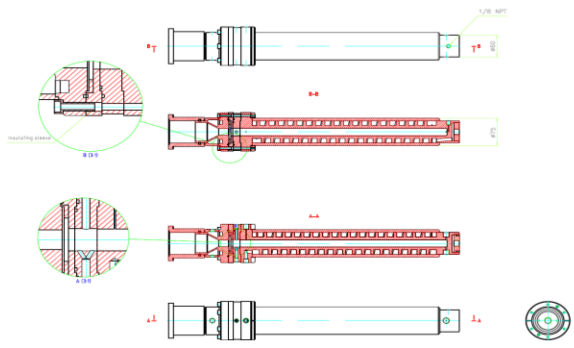

Fig. 2 A 3D CAD diagram of target for I-123

Fig. 3 Photos of target system for I-123

This target is composed of six parts - Collimator, Insulator ring, He cooling window, Target chamber, Target chamber cover and Flange ring. In the Fig.2, Fig.3, the target is constructed to minimize the repairing time and collimator is also cooing with water. Insulator ring insulates the collimator and cooling window in the inner vespel with insulating tape, then Havor Foil is located on both sides of the cooling window. Because the beam enters the target through the Havor foil, helium has to cool down the foil. In Fig.4, water cools down the collimator and target chamber. The target water cooling system is in spiral form in this research, so this system can reduce cooling time with water swirling in the target. I-123 tends to stick to the wall surface of target after the nuclear reaction within the chamber. The Inside of target is gilt with Nickel to make it productive in retrieving I-123. Flange ring holds from collimator to target chamber to prevent the whole system from Leaking.

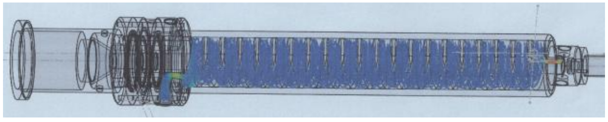

Fig. 4 The View of Target Cooling Simulation

3. Conclusions

Only KIRAMS can produce I-123 radiopharmaceuticals in Korea. So we need to acquire techniques not only supplementing drawbacks of the existing target, but also minimizing the radiation exposure during maintainence of target. The new water cooling system will hold the pressure of the target constantly. This will enhance the yield of I-123. The first development of Xe-124 target in Korea will result in more distributed environment of I-123 to diagnose thyroid gland cancer.

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