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Standardized High Current Solid Targets for Cyclotron Production of Radionuclides

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Introduction

Cyclotron and Radiopharmaceuticals Department (CRP) is an advanced and modern facility that encompasses two essential components:

- Radioisotope research, and
- Radiopharmaceuticals manufacturing

Radiopharmaceuticals manufacturing program is not only quite unique, but also an essential component of King Faisal Specialist Hospital and Research Center (KFSH&RC) in providing quality patient care for the population of the Kingdom. Accurate diagnosis and therapy with medical imaging equipment requires quality radiopharmaceuticals that are available readily and with reliability. CRP department provides that quality and reliability. Research activities of the CRP department are focused on developing new radiotracers with potential usefulness in biomedical research and clinical applications. Research projects consist of:

- developing cyclotron targetry for radioisotope production;
- developing synthesis methods for radiolabeling biomolecules; and
- developing analytical methods for quality control.

CRP department operates a semi-commercial radiopharmaceuticals manufacturing program that supplies the diagnostic radioactive products (see attached list) to several hospitals in the Kingdom and neighboring countries. These products for clinical applications are produced according to the international standards of Good Manufacturing Practices of quality and efficacy.

At heart of the radioisotope program is a medium energy cyclotron capable of accelerating a number of particles for transformation of non-radioactive atoms into radionuclides that are the primary sources for research and development activities, and for preparing radiopharmaceuticals. In addition to having the only cyclotron facility in the region, KFSH&RC also has the only Positron Emission Tomography Center (PET) in this part of the world. This combination of cyclotron and the ultra modern PET facility translates into advanced and specialized care for the patients at KFSH&RC.

Department's multi-disciplinary staff is a blend of engineers, chemists, radiochemists, radiopharmacists, and quality control chemists all working toward KFSH&RC's goal of providing better patient care. The department is committed to the ideal of *Quality in Performance and Pride in Achievement.*

Facilities

The Cyclotron and Radiopharmaceuticals Department began producing radiopharmaceuticals in 1982 with its model CS-30 cyclotron. The cyclotron is capable of accelerating protons, deuterons, helium and alpha particles. To that precision machine and electronic shop is attached to support maintenance and fabrication of some part of the cyclotron together with both internal and external targets. In the radiochemistry section five

advanced hot cells are used to separate radioisotopes as well as include electrodeposition devices for Tl-203, Zn-68, Cd-112 and Te-124. Also the quality control section is equipped with three (Ge-Li) Multi Channel Analyzer detectors, HPLC, GC, TLC scanner etc.

Product list

1- ^{201}Thallium Chloride
2- ^{67}Gallium Citrate
3- ^{111}Indium Chloride / Oxine
4- ^{81m}Krypton Generator
5- ^{123}Iodine solution, capsule, OIH, IMP and mIBG
6- ^{124}Iodine solution
7- ^{18}Fuorodeoxyglucose (FDG)
8- ^{13}Ammonia
9- ^{131}Iodine solution, capsule and mIBG

Overall problem

1- Inadequate supply of the Tl-201, I-123 and I-124 due to limited capability of the solid targets of handling high beam current. This limitation occurred as a result of using classical electroplating methods, which may furnish lower plated targets.

2- Target enriched material recovery system include classical chemical separation techniques which are time consuming, increased radiation exposure and produce large volumes of liquid waste.

3- Lack of knowledge regarding Pd-103 production.

Goals and Objectives

The objective of this project is to improve cyclotron targetry for the production of radiopharmaceuticals used in diagnostic and therapeutic nuclear medicine through:

1- Development of high current solid target,

2- Improvement of the recovery of enriched material effectively in fast manner and

3- Standardize the specifications and quality control of electrodeposited targets.

4- Engagement in collaborations with scientists either within the institution or external institutions in developing collaborative research projects, staff development and technology transfer.

5- Implementation of training program for external students and trainees in cyclotron technology, radiochemistry and quality control.

Detailed Work Plan

In the first period of the project we will be focusing on the following:

1-Prepare copper and platinum reference electrodes according to the specifications suggested by RCM group.

2-Utilize the technology on high quality plating of Tl-203 to produce solid targets according to the proposed targets layer quality control

3- Irradiation Tl-203 targets at different time points and currents.

4- Recovery process for enriched Tl-203after irradiation utilizing the same technology.

5-Accumulated results will be presented on the second RCM.

The same principals will be adapted for the production of I-123 and I-124 in the next period of the project. By all means participating on the development of Rhodium targetry for the production of Pd-103 will of our interest when ever possible.

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