Recent Progress in the Production of Medical Radioisotopes with RFT–30 Cyclotron

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Current status of RFT-30 cyclotron

Production of medical radioisotopes with RFT-30 cyclotron

Future plan
Korea Atomic Energy Research Institute (KAERI)

- **Daejeon**
  - Korea Atomic Energy Research Institute (KAERI)
  - KOrea Multi-purpose Accelerator Complex (KOMAC)
  - 100 MeV proton LINAC

- **Gyeongju branch**
  - 30 MeV proton cyclotron

- **Jeongeup branch**
  - Advanced Radiation Technology Institute (ARTI)
◆ Construction: July 2007 ~ April 2009
◆ 5,565.15 m², 1 basement, 2 stories
1st floor

- Cyclotron main vault, Target irradiation room
- Hot cell zone: RI & Radiopharmaceutical production & care
- GMP zone: RI & Radiopharmaceutical control (plan)
- Hot lab: RI labelling experiment
- Machine workshop
◆ 2nd floor

- Control room for RFT-30
- Lab. of chemical synthesis
- Lab. of chemical synthesis (organic/inorganic)
- Lab. of auto-synthesizer and targetry
- HVAC room Hot & Cold zone

◆ Basement

- Utilities for Cyclotron & Facilities
- Radioactive waste storage
1. RFT–30 cyclotron

► Developed by Korea Institute of Radiological & Medical Sciences (KIRAMS) (2005~2007)

► Specification
  - Ion source: Negative hydrogen ion (H⁻), 10 mA (Max.) (D–Pace, Inc.)
  - RF system: 63.96 MHz
  - Extracted beam: proton (H⁺), using carbon stripper foil
  - Beam energy: 15 ~ 30 MeV
  - Beam current: ~250 μA (Max.)
Carbon stripper foil: stripping 2 electrons from $\text{H}^-$ ($\text{H}^- \rightarrow \text{H}^+$)

Ion source (production of $\text{H}^-$)

Inflector (vertical → horizontal)

Switching magnet (beam line selection)

Current status of RFT-30 cyclotron
2. Beam lines

BL1-1: PET RI production (\(^{18}\text{F}\) etc.)
BL1-2: proton/neutron user service
BL2-1: RI production (solid target)
BL2-2: under development
Production of medical radioisotopes with RFT-30 cyclotron

- Proton-rich radioisotopes, usually β + emitters, are produced.
- Positron Emission Tomography (PET)
Production of medical radioisotopes with RFT-30 cyclotron

Licensing modification (Jan. 2018)
production for research purpose only → production and distribution

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<td>Zr-90</td>
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Production of medical radioisotopes with RFT-30 cyclotron

We are interested in the production of
- $^{89}$Zr, $^{64}$Cu, $^{44}$Sc, $^{57}$Co, and so on.
- Generator system: $^{68}$Ge/$^{68}$Ga, $^{44}$Ti/$^{44}$Sc.
Production of medical radioisotopes with RFT-30 cyclotron

Current status of RI production

1) $^{89}$Zr ($\approx 2$ mCi/µAh)

- once or twice/week
- distributed to major hospitals in Korea
  (including Seoul National University Hospital, Samsung Medical Center)
2) $^{64}$Cu and $^{57}$Co

- $^{64}$Ni(p, n)$^{64}$Cu
- $^{58}$Ni(p, 2n)$^{57}$Cu $\rightarrow$ $^{57}$Ni $\rightarrow$ $^{57}$Co

- Pilot production using natural Ni target
- Separation experiment has been performed.
- Mass production will be carried out using enriched Ni targets.
Production of medical radioisotopes with RFT-30 cyclotron

3) $^{44}\text{Sc}$

$^{44}\text{Ca}(p, n)^{44}\text{Sc}$

- Pilot production using natural CaCO$_3$ target
- Separation experiment has been performed.
- Mass production will be carried out using enriched CaCO$_3$ targets.
Production of medical radioisotopes with RFT-30 cyclotron

4) $^{68}\text{Ge}/^{68}\text{Ga}$

- $^{\text{nat}}\text{Ga}(p, xn)^{68}\text{Ge} \rightarrow ^{68}\text{Ga}$

- first production (Feb. 2015, ~10 mCi)
- 2150 $\mu$Ah irradiation (Aug. 2018, ~80 mCi)
- Separation process is ongoing.

5) $^{18}\text{F}$

- $^{18}\text{O}(p, n)^{18}\text{F}$

- If requested
- User support including labelling experiment, imaging, and so on
Production of medical radioisotopes with RFT-30 cyclotron

Selected as ‘Top 100 national R&D performance in 2018’
Educational support

- **IAEA/WCI/KAERI training course**
  - Title: Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application
  - 2018.10.23~10.26 (4 lecture, 1 exercise)

- **RCARO/KAERI introductory training**
  - Title: Introductory Training Course on Radiation Technology and its Applications
  - 2018.10.23~10.24 (2 lecture)

- **KOICA/IAEA/KAERI joint training program**
  - Title: Introductory Training Course on Radiation Technology and its Applications
  - 2018.09.18. (2 lecture)

*WCI: World Council on Isotopes
*RCARO: RCA (Regional Cooperative Agreement in Asia and the Pacific region) Regional Office
*KOICA: KOrea International Cooperation Agency
Future Plan

▶ Production of more various RIs
  – $^{67}$Cu, $^{55}$Co, $^{103}$Pd, and so on

▶ Production & Distribution
  – F−18: on-site research user
  – Zr−89: 130mCi/batch → 500 mCi/batch
  – Ge−68: 80mCi/batch → ~1 Ci/batch, Generator
Thank you for your attention!