# Development of a Krypton Target for Cyclone-30 at KFSH&RC

F. Alrumayan[a,1], F. Oberdorfer[b], Q. Akkam[a], J. Schneider[a], S. Alyanbawi[a], I. Al-Jammaz[a]

[a]King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia
[b]ZAG Zyklotron AG, Karlsruhe, Germany

## Introduction

Krypton-81m is a radioactive gas with a half-life of 13 s, and found to be useful in many applications in nuclear medicine, particularly for lung perfusion studies and ventilations. Due to high demands for $^{81m}$Kr, we have developed an automated Krypton system to be installed in one of the Cyclotron's beamlines at King Faisal Specialist Hospital and Research Centre (KFSH&RC) and to deliver large activity of the radioactive gas.

## Material and Methods

The effective cross section of producing $^{81}$Rb is between 15 and 30 MeV [1]. Therefore, range and stopping power of the effective cross section were calculated with respect to gas density of 0.0185 g/cm$^3$. This value is equivalent to gas density at 5.0 bars at room temperature. SRIM calculations resulted in a range of 589 mm. However, due to limitation in fabricating such long target chamber, the target length is chosen to be 250 mm. Attached to the end of target body is a special water circulating flange 'backpool', its purpose is to absorb the rest of the energy and protons Bragg peak. The target body is made of Aluminum with the inner part being electroplated with nickel. The target body is of conical shape. The target body is electrically isolated from other parts to allow accurate beam current reading.

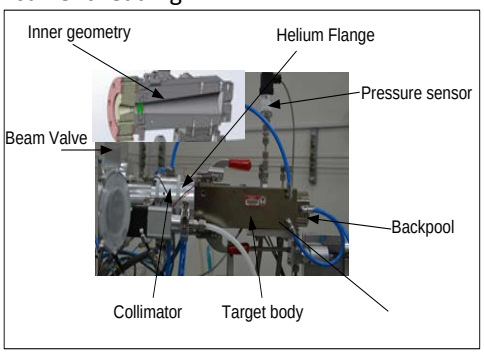


FIGURE 1. Krypton target attached to the cyclotron beamline. A cross section of the target model is also displayed.

Full access to the target loading/unloading steps is made through touch screen technology (FIG. 2) for user access. Additionally, the target control system is designed to be protected through chain of interlock steps. The production cycle of $^{81}$Rb is explained as follow. Target is evacuated to approximately $10^{-3}$ mbar before being filled with $^{nat}$Kr at pressure of 5 bars. At the end of bombardment, recovery of $^{nat}$Kr is done via cryogenic vessel. Finally, the radioactivity is washed with KCl and pushed to Hotcells through the nitrogen gas for chemistry processing. Irradiation time was approximately 30 min.

FIGURE 1. User interface Touch screen

## Results and Conclusion

Experimental results clearly showed a fairly good activity of $^{81m}$Kr as shown in TABLE 1. In all experiments, the radionuclidic purity of $^{81m}$Kr was above 99.59%. $^{79m}$Kr and $^{79}$Kr were also measured with a percentage of, respectively, 0.34 and 0.07 %. Special attention has to be drawn to last experiment where the yield significantly increased, due to the period where the KCl left inside the target (10 min) before pushing the solution to the Hotcells.

| I (μA) | $P_{int}$ | $P_{final}$ | $A_{@EOB}$ | Yield (mCi/μAhr) |
|---|---|---|---|---|
| 10 | 4.70 | 6.98 | 19.99 | 3.77 |
| 10 | 4.70 | 7.14 | 17.28 | 3.46 |
| 10 | 4.70 | 7.00 | 22.83 | 4.15 |
| 10 | 4.93 | 7.36 | 31.16 | 4.70 |

TABLE 1. Experimental results of $^{81m}$Kr activity

## References

1. Z. Kovacs et al.: *Int. J. Rad. Appl. Instrum.;* **42**(4), pp. 329–335, 1991.

[1]Corresponding author, E-mail: rumayan@kfshrc.edu.sa