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PREPARATION OF ^{63}Ni ELECTRODEPOSITED SPECIAL CUSTOM-MADE SOURCES

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Abstract

^{63}Ni is used as an ionization source in electron capture detector of Gas Chromatography. Different firms currently use such sources with a few tens of MBq activity, uniformly deposited on different size and shapes of metals. ECIL, Hyderabad, requested for ^{63}Ni beta ionization source of ~370 MBq (~10 mCi) on a delicate custom made holder, which was successfully carried out by us by electrodeposition method. This paper describes the fabrication of such ^{63}Ni custom-made source (exclusively coated on inner curved area of up to ~3.2 sq.cm. on Nickel alloy metal) in detail.

Introduction

^{63}Ni a pure beta emitter with half life of 100 years and $E_{\beta max}$ 0.067 MeV is used as low energy beta ionization source[1]. β- particles from ^{63}Ni source produce ionization resulting in a steady current in a stream of pure argon. When any other gas with a higher electron capture enters the chamber, the change in the current enables detection of the type and amount of the gas (Fig. 1) [2]. A request was received from M/s Electronics Corporation of India Limited, Hyderabad for a ^{63}Ni source of ~370 MBq (10mCi) strength, in the form of a Nickel ring for use in Gas Chromatography equipment. Electrodeposition is the most suitable technique for such preparations as thin films on prescribed dimensions, to achieve well-adhered deposit.

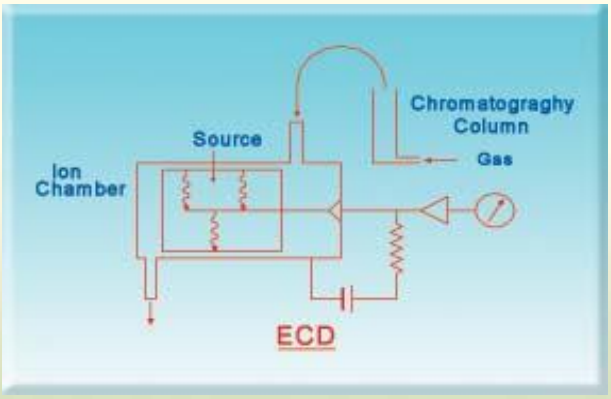

Fig. 1 : Ionization source set-up

Materials and Method

^{63}Ni was procured from M/s Amersham Biotech Pharmacia, UK. All other chemicals like Boric Acid, Nickel Chloride and Ethyl alcohol were of AR grade and procured from SD Fine Chemicals, Mumbai / BDH (India). The Nickel ring to be coated with ^{63}Ni was provided by ECIL, Hyderabad (Fig. 2).

A special cell was designed and used to mount Ni alloy ring holder. The Ni alloy holder was mounted suitably in between two thin rubber sheets and pressed tightly with butterfly screws ensuring no leakage of electrolyte (Fig.3).

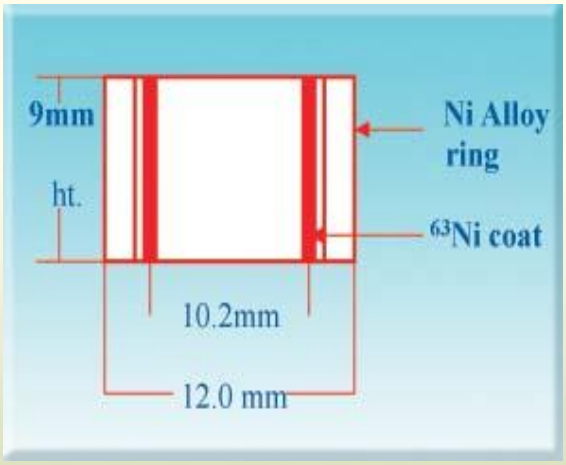

Fig. 2 : Nickel ring

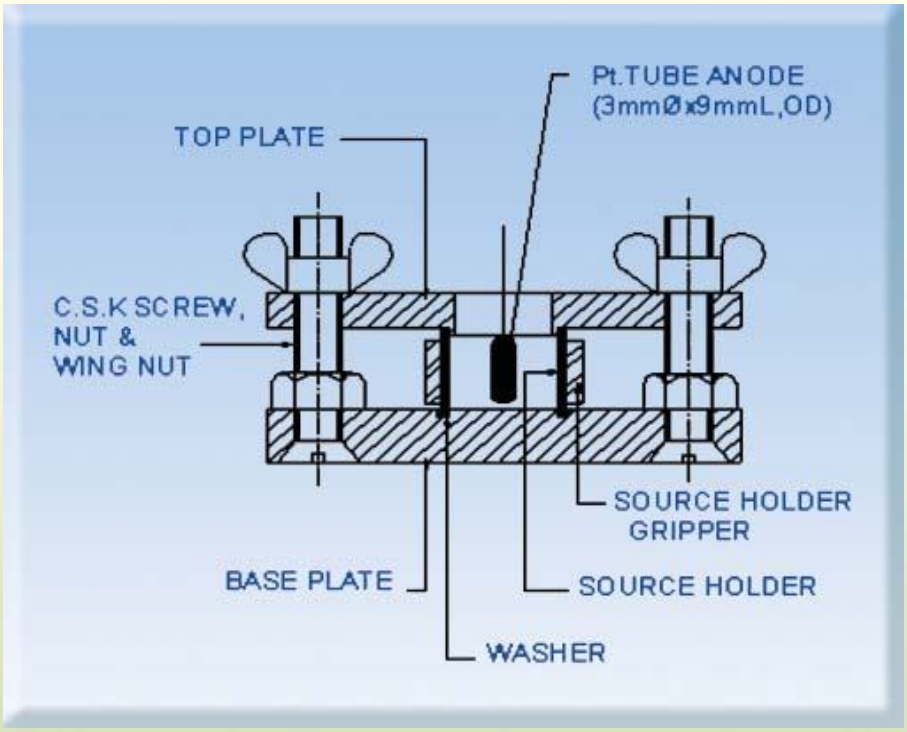

Fig. 3 : Electrodeposition cell assembly

Based on previous[4] experience with preparing electro deposited ^{63}Ni sources, the following procedure was adapted. ~370 MBq (~10 mCi) of ^{63}Ni was to be deposited uniformly and accurately only in the inner curved portion of annular Ni Alloy ring holder of 12 mm diameter X 10 mm height with an inner diameter of 10.2 mm ID. The electrolyte (pH of 2–2.5) was composed of Boric acid (30 g/L), ~370 MBq (~10 mCi) ^{63}Ni as Nickel Chloride with a specific activity of 6.1 mCi/mg in a total volume of 0.8 ml. The electro-deposition was carried out for 4 hours maintaining electrolyte volume of 0.8ml, by addition of electrolyte (free from Ni carrier) occasionally to compensate for the loss of electrolyte volume. The source activity was assayed by drawing suitable electrolyte aliquots, before and after the electro-deposition. These samples were counted in the Liquid Scintillation Counter. At the end of electro-deposition, the source was washed with DDW, alcohol and dried. The electrodeposited ^{63}Ni source was heated to ~500°C to convert Ni to Nickel oxide and cooled. The source was then subjected to leach test for the adherence compliance quality in accordance with AERB standards.[4]

The net electrolyte reaction is

$$2\,Ni^{+-} + 2\,H_2O \rightarrow 2\,Ni + 4\,H^+ + O_2 \quad (E_0 = -0.25V)$$

Results

At the end of 4 hour electro-deposition, > 90% ^{63}Ni could be deposited. The leach test results indicated that < 0.01% of activity leached out, which was well within the permissible levels.

Conclusion

The electro deposition described is a very safe and reliable procedure to coat ^{63}Ni on any flexible dimensions of custom source holders. The specially developed electrodepositing cell set-up is useful for plating on such small annular space area of the rings. Such sources are regularly supplied to various users on commercial basis through BRIT/DAE.

Acknowledgement

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References

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ABOUT THE AUTHORS

Ms Shyamala S. Gandhi obtained her B.Sc. degree in Physics from Mumbai University in 1993 and PG Diploma in Computer Science and Applications from SNDT University, Mumbai in 1994 and joined BARC in 1997. She is involved in the regular fabrication of reference radiation sources, supplied to various users on commercial basis through BRIT. She has also participated in the development of custom made special sources such as polymer film sources using ^{60}Co and sources based on ^{147}Pm, ^{55}Fe and ^{63}Ni etc., for their use in various fields.

Mr J. Udhayakumar obtained his B.Sc. degree from Madras University in 1975 and joined BARC in 1976. He has worked on the development of ^{57}Co-mossbauer sources, ^{241}Am smoke detector source, ^{204}Tl sources etc. He has also contributed to the development of ^{60}Co and ^{57}Co gamma film sources and ^{147}Pm source for beta dust monitors. He has been involved in the preparation of electrodeposited sources comprising of ^{57}Co, ^{60}Co, ^{125}I, ^{55}Fe, ^{109}Cd, ^{63}Ni etc. Presently he is responsible for the fabrication of reference sources supplied to various users on commercial basis through BRIT. He has one research paper in an international journal.

Dr Ashutosh Dash joined BARC in 1983 after successful completion of the 26th batch of training school. He obtained his PhD degree in Chemistry from Mumbai University in 1994. His areas of expertise are fission products separation, large scale handling and vitrification of ^{137}Cs, separation of radioisotopes by ion exchange methods etc. He was on deputation to Korean Atomic Energy Research Institute (KAERI) as a Visiting scientist from November 2002 to April 2003. He was a member of IAEA sponsored CRP projects related to development of therapeutic radiation sources and development of generator technologies for therapeutic radionuclides. He is presently heading the T&RS Section of RPhD and looking after the program of production and supply of brachytherapy, industrial and reference sources. He has been involved in various capital plan projects of the Radiopharmaceuticals Division. He is a member of various departmental committees. He has more than 50 research publications including 10 publications in international journals. He is a life member of NAARRI, IANCAS and INS.