Preparation of enriched ^{170}Er target sandwiched in ^{12}C

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Introduction

Preparation and storage of rare earth material targets are challenging as they are chemically very much active. Targets of ^{170}Er were required for measuring cross-section of Evaporation Residues (ER) as well as spin distribution of ER produced in heavy ion reaction. 200 μg/cm^2 (220 nm) thick self supporting targets or targets with thin backing of low Z material were preferred. Erbium reacts with Oxygen as well as with water slowly at room temperature but it reacts readily at higher temperature. For Erbium with melting point 1529°C, resistive heating was found to be suitable method for deposition.

Preparation of self supporting Er targets has been reported by D J Yaraskavitch[1]. H Folger et al.[2] reported preparation of 450 μg/cm^2 of ^{170}Er targets on 40 μg/cm^2 thick C backing and 8 μg/cm^2 thick coating of C on it to prevent Oxydation.

1. Experimental Setup

Diffusion pump based coating unit (High Vacuum evaporator) at IUAC, New Delhi was used for the deposition of Erbium as well as Carbon. The vacuum was achieved and maintained in the range of 10^{-7} mbar. ^{12}C was deposited using electron gun whereas for Er resisitive heating method was used. For substrate heating, two Halogen lamps of power 90 watts were used just above the glass slides and temperature was measured with the help of a thermocouple. Thickness was measured during the deposition with the help of Quartz crystal monitor placed inside.

Self supporting targets of Er were fabricated by depositing 100 nm NaCl on glass slide followed by 220 nm of Er. Self supporting targets were made successfully but when kept in atmosphere to check their stability they did not last for more than 2 days due to oxidation.

To fabricate sandwiched targets $BaCl_2$, C, Er and again C were deposited respectively on glass slides and the whole assembly was floated in water to dissolve the $BaCl_2$. Optimization of substrate temperatures was done to have successful deposition as well as floating. $BaCl_2$, C, Er and C were deposited maintaining the substrate temperatures 280° C for $BaCl_2$, 260 °C for first C, 240 °C for Er, and 220 °C for the next C. After the deposition was over, the temperature was maintained at 200 °C for an hour and then cooled very slowly. During this whole process the vacuum was maintained at 10^{-7} mbar. The thicknesses of layers were varied to have better efficiency for deposition as well as floating. 100 nm $BaCl_2$, 200 nm C, 150 nm Er and 100 nm C were deposited and floated to have sandwiched Er targets.

Many other methods were also tried but above one was found to be most suitable. Among the other methods, Er was deposited on self supporting C of different thickness(50 nm, 100 nm, 200 nm) but they got damaged shortly after starting Er deposition. Increasing the substrate temperature helped to some extent but the required thickness could not be achieved. Without increasing the substrate temperature, deposition of the whole assembly of $BaCl_2$, C, Er and C on glass slides could not be done successfully as layers started peeling off during deposition of Er or the 2nd layer of C.

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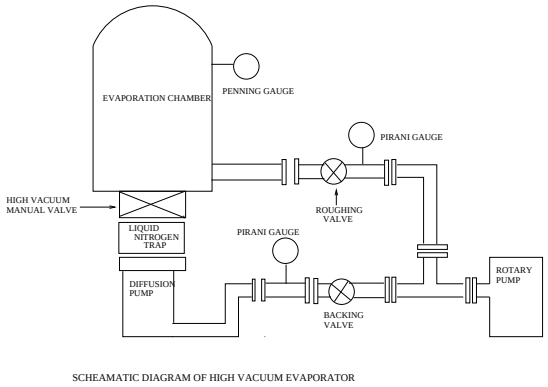

FIG. 1: The schematic diagram of the High Vacuum Evaporation chamber.

2. Result and Conclusion

130 μg/cm^2 thick targets of enriched ^{170}Er sandwiched between two C layers of thicknesses 45 μg/cm^2 and 23 μg/cm^2 respectively, were prepared successfully. Instead of depositing Er on self supporting C, floating the whole assembly of C-Er-C gave better efficiency. To know the purity of the target, XRF was done and no high Z impurity was found. The targets were stored in Argon environment and they survived for a long period of 7 months. An experiment, spin distribution in fusion reaction ^{30}Si+^{170}Er was carried out successfully with these targets.

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References

[1] D. J. Yaraskavitch, Y. K. Peng World Conference of International Nuclear Target Development Socity, Argonne National Laboratory 1983

[2] H Fogler, W Hartmann, F.P.HeBberger, S.Hofmann,J. Klemm, G. Munzenberg, V. Ninov, W. Thalhemer, P. Armbruster, Nucl. Inst. and Meth A 362(1995)64