Fabrication of thin ^{206}Pb targets for study of fusion-fission dynamics

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Introduction

Heavy ion induced fusion-fission has been extensively used to understand the dynamics of reaction process and compound nucleus survival probability. This has significance to the formation of heavy elements. Compound nucleus ^{225}Pa has been populated using reactions ^{16}O+^{209}Bi and ^{19}F+^{206}Pb around barrier energies. One of above reactions (^{19}F+^{206}Pb) has been performed using Pelletron with pulsed ^{19}F beam with seperation of 250 ns at IUAC, New Delhi. Thin enriched isotopic ^{206}Pb targets with thin ^{12}C have been successfully fabricated using physical vapor deposition technique in Target Development Laboratory of IUAC. Thickness of isotopic ^{206}Pb target have been measured using Rutherford Backscatering (RBS) method. Isotopic ^{206}Pb target has been used in the mass-distribution studies for ^{19}F+^{206}Pb reaction.

Experimental Setup

^{206}Pb targets were fabricated in a Diffusion pump based coating unit. Coating unit is equipped with thermal heating arrangement, electron gun, quartz crystal thickness monitor, manually operator shutter, liquid Nitrogen trap as shown in Fig.1. Diffusion pump coating unit is required for attaining high vacuum(1.1×10^{-6} mbar). Quartz crystal thickness monitor is used to monitor the film thickness and depostion rate during the evaporation. Manually operated shutter was used to control the vapour depositon during evaporation. Liquid nitrogen cold trap was placed between bell jar and diffusion pump to avoid the oil contamination from Diffusion pump. 110 μg/cm^2 of ^{206}Pb was deposited on the layer of 20 μg/cm^2 of ^{12}C.

Barium-Chloride (BaCl2) was selected as releasing agent [1] for the separation of thin film of thin ^{12}C backing from substrate. Before starting the deposition, pellet of $BaCl_2$ was made using hydraulic press. $BaCl_2$ Pellet was kept in Tantalum boat and ^{12}C pellet was placed in special kind of Tantalum boat having less solid angle of evaporation to minimize the material consumption. Pre cleaned glass slides were kept inside the bell jar.

Distance between source and glass slide were optimized such that material loss can be minimized due to evaporation. For the deposition of $BaCl_2$, distance between source and glass slide was fixed at 18 cm.

Initially current were kept low (around 80 Amp) for heating of Tantalum boat to remove other contamination in pellet, boat. Slowly current increased upto 165 Amp. Vacuum inside the chamber maintained during the evaporation was around 1.1×10^{-6} mbar. ^{12}C pellet was evaporated using the electron gun set up. ^{12}C deposited slides were anealed in Argon atmosphere at 325 °C for 2-3 hours. Anealed ^{12}C deposited slides were clamped with stainless steel stand at distance of 8 cm from source such a manner that material consumption could be minimized.

Several attempts were made with natural material in order to optimize all parameters for reducing enriched ^{206}Pb material consumption. In each run chamber was cleaned for avoiding any contamination. The resistive heating method was used for ^{206}Pb material evaporation. Optimized parameters (current 120 Amp, voltage 1 volt and vacuum 1.3×10^{-6} mbar) were employed during whole evap-

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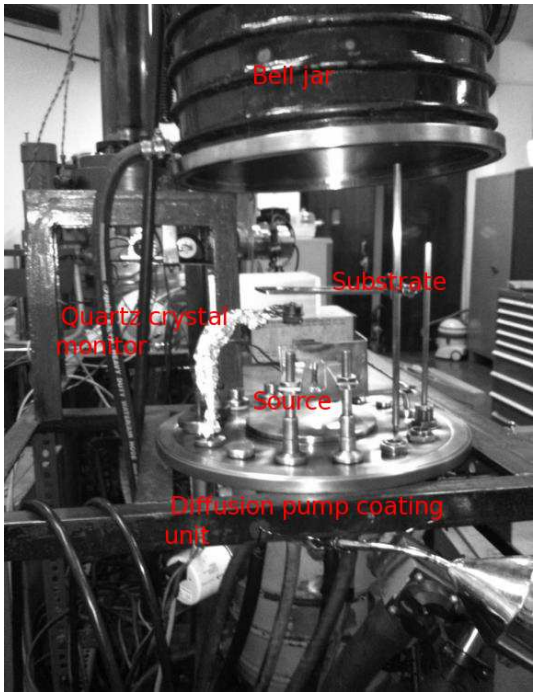

FIG. 1: Experimental set up and different components of High Vacuum Evaporator are shown in Fig.1.

ration.

^{206}Pb thin films were seperated from glass slide in hot water. Floated ^{206}Pb thin films were gently taken out from hot water with help of stainless steel target frame with diameter of 10.0 mm.

In heavy ion induced reaction, mass and energy of reaction products are the important important. Knowing exact energy loss in target and impurity in target can help calculating these parameters. These can be obtained from target thickness and purity of material. For this purpose, Rutherford Backscattering Spectrometry (RBS) of ^{206}Pb target with carbon backing was performed using Pelletron Accelerator RBS-AMS Systems (PARAS) at IUAC, New Delhi. Analysis of experimental backscatter data was done with help of software RUMP [2]. Lead isotopes are oxidizing in nature which have been also observed in RBS specturem of ^{206}Pb target (Fig.2).

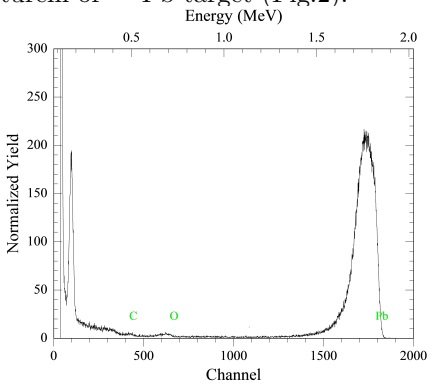

FIG. 2: Experimental RBS RBS specturem of ^{206}Pb are shown Fig.2. In Fig.2. ^{12}C, ^{16}O peaks are distinctly shown which is lying in lower mass region.

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