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60 Abstract : This report describes the method developed for the preparation of ^{241}Am source for smoke detector. Americium was electrodeposited from iso - propyl alcohol medium on silver backing. Thin layer of gold (few hundred micro gram thick) was platted on the americium source to make it safe for handling. The thickness of platted gold was such that the alpha radiations from the ^{241}Am source could escape out of the gold layer and cause ionisation in the surrounding air. The performance of the prepared sources were checked in a smoke detector and was found to be satisfactory and comparable to the imported sources.

70 Keywords/Descriptors : AMERICIUM 241; ELECTRODEPOSITION; SMOKE DETECTORS; THIN FILMS; FOILS; GOLD; SILVER; ALPHA SOURCES

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PREPARATION OF AMERICIUM SOURCE FOR SMOKE DETECTOR

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1. INTRODUCTION

Sealed americium sources are used for the detection of smoke in its vicinity. The smoke is ionised by the alpha and/or gamma radiation of ^{241}Am and the increase in the ionisation current gives an early alarm of the fire. If the alpha radiation of the americium source is used for the ionisation then relatively very small amount of americium would be required for the smoke detection. This requires a safe alpha source from which the alpha radiations can come out and also the chance of alpha contamination due to loose americium is negligible. The smoke detectors currently use such ^{241}Am sources which are imported from USA and Japan. The assembling of the smoke detector is done locally in India. Efforts have been made to make such Am sources in our laboratory. This paper gives the details of our work. Preliminary data of this work has beeen presented elsewhere [1(1)]

2. EXPERIMENTAL

Few imported ^{241}Am sources were obtained from Isotope division of BARC.These sources were found to contain 1.22 μc. of ^{241}Am on silver backing. These sources were covered with gold (thickness 2.3img/cm as determined by the alpha energy degradation.). We have tried to make similar sources in our laboratory. The work involved following stages.

1. Deposition of ^{241}Am on silver foil.
2. Fixing of the alpha activity on the foil.
3. Deposition of gold on the sources.

2(1). Deposition of ^{241}Am on Silver foil.

The required amount (1.22μc) of ^{241}Am was deposited on silver foils by electrodeposition from isopropyl alcohol medium.The ^{241}Am was evaporated to near dryness and taken in isopropyl alcohol medium. This solution was taken in the standard electrodeposition cell. Silver foil was used as cathode and a platinum wire was used as anode. A voltage of ~600 volts and a current of 2-3 mA was used for the deposition. The current was passed for 30 minutes for ~95% deposition of ^{241}Am. After deposition the sources were washed with water and acetone and dried under infra red lamp. The alpha activity of these sources were determined by counting them in alpha proportional counter. Table-1 gives the alpha activity of the prepared sources. The alpha activity of one of the imported source is also shown along with for comparison.

2(2). Fixing of alpha activity

Generally the alpha activity on the electrodeposited source is fixed on to the metallic surface by heating the source on the gas flame to a red hot temprature. Silver has a melting point of 850°C. The americium sources were baked at 650°C for two minutes and allowed to cool to fix the ^{241}Am activity on to the silver surface. The alpha activity of the heated sources is also shown in the Table-1.It can be seen from the alpha activity data that there is no loss of ^{241}Am on heating. The alpha spectrum of the baked source was taken on a silicon surface barrier detector coupled to a 4K MCA and is shown in the Fig (1). The alpha spectrum does not show any degradation. Some standard tests to check for any loose alpha activity on the electro deposited sources was carried out. Two sources [source 1 and 2] were subjected to rubbing by tissue paper and were washed under a jet of water and left open in the air to dry .The alpha activity of the dried sources were again estimated by alpha counting . Table- 1 gives the alpha counts of these sources. It can be seen from the table that the activity gets fixed on the surface of silver foil by heating and does not come out either by rubbing or exposer to moisture.

2(3). Deposition of Gold on the americium sources.

Examination of the imported ^{241}Am source showed that gold has been electrochemically plated over the source surface.We also tried different methods to plate gold on the americium sources. The following composition of gold -cynide bath gave the best result.

(i) Gold solution 2.1 mgs /ml of gold as gold chloride.
(ii) Cynide solution 5.4 mgs/ml of KCN in water

Equal volumes of both the solutions were mixed and heated to a temparature of 70 C. Platinum was used as anode and the americium source was made cathode. A current of 0.2 mA was passed during the gold plating. The gold plating was carried out for a time period of 30 secs to 3 minutes. Six americium sources were gold plated using this method.

3. RESULTS AND DISCUSSION

The alpha activity of the gold plated sources were determined by alpha counting and the values are given in the Table-1. It can be seen from the alpha activity values that all the alpha particles are able to come out of the gold deposit. The alpha spectrum of these sources were taken on the surface barrier detector coupled to a multichannel analyser and is shown in the Fig (2). The alpha spectrum shows degradation due to the gold layer. From the extent of degradation the thickness of gold deposit on the americium sources were calculated and the values

are also shown in the Table-1. The imported source has a thicker deposit of gold as compared to the sources prepared by us.The swipe test on these sources were carried out and seen to be within the prescribed limits. These sources were assembled in a prototype smoke detector and were seen to perform efficiently. The americium sources prepared by this technique can be very effectively used in the smoke detector , thereby saving precious foreign exchange for our country. Efforts are underway for the bulk production of such sources.

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4. REFERENCE

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Paper presented in Nuclear Chemistry and Radiochemistry Symposium held at Visakapatnam India Dec 21-24 (1992).

TABLE-1

ALPHA ACTIVITY OF THE AMERICIUM SOURCES.

S.No.	Alpha activity (cps)				Thickness of gold deposit μ gm/cm^2
	Electro deposited source	After heating	After drying	After gold deposition	
Std. source	17582				2310
1.	18031	18108	18082	18198	316
2.	17916	17790	17503	17990	574
3.	19648	19528		19806	217
4.	13002	13374		12807	334
5.	9958	9975		10230	305
6.	21337	21400		21482	312

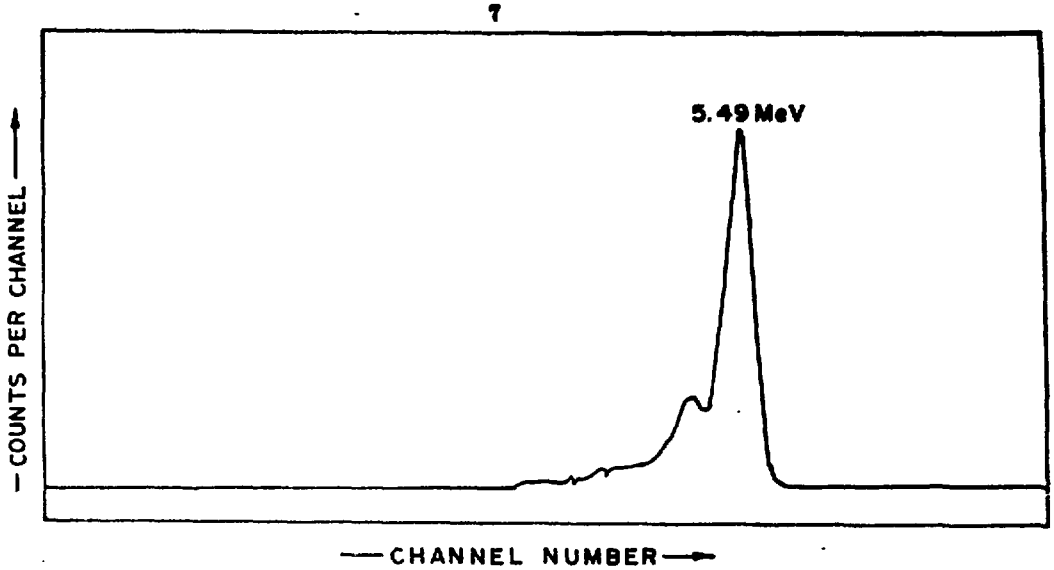

FIG.-1. ALPHA SPECTRUM OF ELECTRODEPOSITED ^{241}Am SOURCE

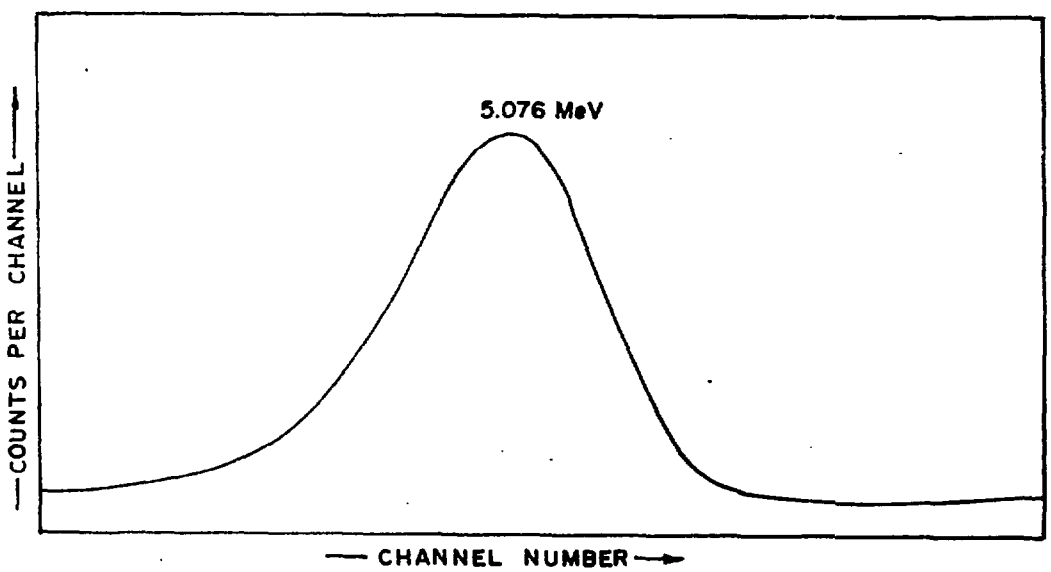

FIG.-2. ALPHA SPECTRUM OF GOLD-PLATED ^{241}Am SOURCE

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