ELEMENTAL ANALYSIS OF ALUMINIUM BASED ALLOYS USING 14-MeV NEUTRONS

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Elemental concentration has been estimated in aluminium based alloy samples, using 14-MeV neutron activation analysis. The results are in agreement with those obtained by atomic absorption spectroscopy.

INTRODUCTION

This paper reports results on elemental analysis of aluminium based alloys. The work was carried out particularly with the interest to find contents of elements in aluminium alloy used for making electrodes of the vibrating type ion source of this laboratory. While studying a typical sample of aluminium alloy in the vibrating ion source, ion current peaks of $^{63}$Cu, $^{56}$Mn and $^{64}$Zn were recorded in addition to $^{27}$Al. It was therefore of interest to know the concentration of these three elements in
the specimen alloy. The samples were irradiated with 14 MeV neutrons, obtained from the neutron generator of this laboratory and the induced γ-activity was detected by an Ortec GM series HPGe detector and recorded on the MCA Canberra series 40.

EXPERIMENTAL

Aluminium alloy rods were ground to form fine granules. Samples were prepared by packing granules /1 g/ into polyethylene bags. Ten such samples were prepared from each type of alloy rod.

Five such samples were separately irradiated with 14 MeV neutrons of flux $4 \times 10^8$ n cm$^{-2}$ sec$^{-1}$ for a period of 30 min and the induced γ-activity was immediately recorded for a period of 30 min. In all the five samples, photopeaks at energies 0.18, 0.511, 0.669, 0.84, 0.962, 1.03, 1.434, 1.47 and 1.74 in MeV were obtained. The various possible nuclear reactions which can be induced are shown in Table 1. Using an elemental search computer programme, developed in this laboratory, the exact energies of γ-rays were calculated. After the analysis the photopeaks were found to be due to $^{63}$Zn /0.669, 0.962 MeV/, $^{52}$V /1.434 MeV/, $^{62}$Co /1.47, 1.74 MeV/ and $^{27}$Mg /0.18, 0.84, 1.03 MeV/. In order to confirm that the recorded γ-activities were due to elements Zn, Mn and Cu a separate experiment was performed.

Samples of ZnO, MnO$_2$ and CuSO$_4$ /99.9% pure/ were mixed and packed in polyethylene bags along with fine aluminium powder /99.99% pure/. Total weight of this sample was 1 g with individual contents of Zn, Mn and Cu less than 0.10%. This sample was irradiated with 14 MeV neutrons and the induced γ-activity was measured. The periods for irradiation and counting were the same as those kept for the aluminium