Development of Alpha Spectroscopy Method with Solid State Nuclear Track Detector Using Aluminum Thin Films

Nidal Dwaikat [a,b], G. Saffarini[c]

[a] *Department of Physics, college of Science, King Fahd University of Petroleum & Minerals,Dhahran 31261, Saudi Arabia.*

[b] *Radiation Physics Research Laboratory, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia.*

[c] *Department of Physics, An-Najah National University, Nablus, Palestine*

ndwaikat@kfupm.edu.sa , nidaldwaikat@yahoo.com

Abstract

This work presents the development of alpha spectroscopy method with solid-state nuclear track detectors using aluminum thin films. The resolution of this method is high, and it is able to discriminate between alpha particles at different incident energies. It can measure the exact number of alpha particles at specific energy without needing the calibration of alpha track diameter versus alpha energy. This method was tested by using Cf-252 alpha standard source at energies 5.11 Mev, 3.86 MeV and 2.7 MeV, which were produced by the variation of detector -standard source distance. On front side, two sets of detectors (five each), were covered with two Aluminum thin films of different thicknesses and the third set of detectors were kept uncovered. The thickness of Aluminum thin films was selected carefully (using SRIM 2013) such that one of the films will block the lower energy alpha particles (3.86 MeV and 2.7 MeV) while the alpha particles at higher energy (5.11 MeV) can penetrate the film and reach the detector's surface. The second thin film will block alpha particles at the lowest energy 2.7 MeV and allow alpha particles at higher two energies (5.11 Mev and 3.86 MeV) to penetrate and produce tracks. For quality assurance and accuracy, the detectors were mounted on thick enough copper substrates to block exposure from the backside. For uncovered detector (third set), alpha particles at three different energies can produce tracks on it. The tracks on the first set of detectors are due to alpha particles at energy of 5.11 MeV. The difference between the tracks number on the first of detectors and the tracks number on the second set of detectors is due to alpha particles at energy of 3.8 MeV. Finally, by subtracting the tracks number on the second set of detectors from the tracks number on the third set of detectors (uncovered), we can find the tracks number due to alpha particles at energy 2.7 MeV. Thus, the discrimination between alpha particles at different incident energies is achieved. Therefore, knowing the efficiency calibration factor, one can exactly calculate the activity of the standard source.

Keywords: 1) CR-39 Detector 2) copper substrate 3) Aluminum 4) Alpha particles