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OPTICAL CONSTANTS CORRELATED WITH ETCHING AND IRRADIATION TIME OF LR115 DETECTOR BOMBARDED WITH A-PARTICLES FOR DIFFERENT IRRADIATION TIMES

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Abstract

LR 115 is one of the ideal Solid State Nuclear Track Detectors (SSNTD's), which is frequently used to learn more about cosmic rays, long-standing radioactive elements, radon concentration in houses, and the age of geological samples. The effects of α-particles on the optical constants of LR115 polymer were investigated. The detector LR115 were bombarded with 5 MeV alpha particles normal incident for different times (0,3,6,9,12,15)days at room temperature, using an ^{241}Am source.The effects of α-particles irradiation and etching with 2.5NNaOH aqueous solution at 60 0C by a water bath on the optical constantsof LR115 are studied through the measurements of UV/Visible spectrophotometer with wave length range (600-1000)nm.
Transmittance and absorbance measurements in the waves length range(600-1000)nm were used to calculate the refractive index n and extinction coefficient k . The optical band gap Eg(= E_{opt}^{WD}) , complex dielectric constant ε_1, ε_2, ε_∞, average interband oscillator wave length λ_0,average oscillator strength So, N/m*(N the free charge carrier concentration , m* the effective mass of the free charge carrier). According to Wemple and Didomenico method, the optical dispersion parameters $E_o$and $E_d$were determined.

Keywords: LR115 track etch detector; etching time; Optical constant; alpha irradiation; UV/VIS spectroscopy; optical properties: refractive index.

1.Introduction

Polymer are one of the most important materials that can be used in different fields from everyday life to high technology engineering. Solid State Nuclear Track Detectors (SSNTD's) is one of these polymer types that have been used for applications, such as biological filter, fission and nuclear physics; space physics, the study of meteoritic and lunar samples; cosmic rays; particle accelerators and reactors; metallurgy, geology,archaeology medicine; and many others.[1-5]. In the early days, the optical properties of irradiated (SSNTD's) by charge particles, neutron and gamma-ray irradiations were mainly investigated [6-12].
They acquire many advantages over the others, such as easily processional, low coast in manufacturing, low weight, excellent surface transparency, high efficiency in ion-registration, etc.[13-16].
When the ionizing radiation passes through a polymeric track detector, its produces damage trail called latent tracks[17]. These latent tracks can be developed and visualized by means a suitable chemical etchant that helps them to enlarge. It is known that the bulk etch rate depends on the etching time, chemical etchant temperature, and the concentration of etchant[18,19]. The visualize and account the latent tracks, the traditional treatment has been determination by an optical microscope. Several techniques are used to developed the traditional method to count the etch pits tracks[20-23].

2. Experimental details

Plastic LR115 detector sheet is one of trademarks of the family of cellulose nitrate with redcolored, pursed from Kodak Path-France, molecularcomposition $(C_{12}H_{17}O_{16}N_3)_n$, and thickness 12μm are
cut in pieces of (2x2.5)cm^2. Samples of LR115 are exposed to perpendicularly incident alpha particles (main energy 5MeV in air) emitted from ^{241}Amsource. The irradiation are carried out in air at roomtemperature at a distance from the source of 0.51cmwhich correspond to α-particles energy of 5MeV. The^{241}Am source is free from collimators to be sure thatthe area of the target material LR115 (5cm^2) is whollyirradiated. Several irradiation times are taken(3,6,9,12,15)days at the same conditions. Then LR115is chemically etched with 2.5N solution of NaOH andkept at temperature 60^{0}C by using automatic waterbath