# Studying the Effects of Irradiation with Alpha Particles and Etching on the Optical Energy Band Gap of LR115 Detector

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**Abstract:** LR 115 is one of the ideal Solid State Nuclear Track Detectors (SSNTD's), which is frequently used in the numerous application and studies in applied science. The effects of α-particles irradiation and etching with 2.5N NaOH aqueous solution at 60 $^0$C by a water bath on the absorbance **A**, transmittance **T**, reflectance **R** and optical energy band gap **Eg** of LR115 are studied through the measurements of UV/Visible spectrophotometer with wave length range (200-1000)nm. The irradiations are performed by using $^{241}$Am source at constant alpha particle energy 5.48 MeV normal incident for different irradiation times (0, 3, 6, 9, 12, 15)days. Exposure of LR115 detector to α-particles doses and etched, causes a great effect on the structural of LR115 films. The energy band gap of LR115 films irradiated with α-particles is calculated before and after etching. The values of optical energy band gap **Eg** are found between (1.885-1.870)eV without etching and between (1.875-1.800)ev with etching, for irradiation times (0-15) days respectively. From these results, we can reveal that the values of energy gaps without etching (before and after irradiation) greater than those with etching. Thus, variations in the optical energy band gap Eg values may be due to the formation of defects (radicals and organic species) in LR115 films due to alpha irradiation. The number of carbon atoms has been determined in each case for optical energy gap.
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**Keywords**: LR115 track etch polymer; etching time; Optical band gap energy; alpha irradiation; UV/VIS Spectroscopy; optical properties: number of carbon atoms.

## 1. Introduction

The irradiation of polymers with ionizing radiations leads to a wide variety of changes in their physic-chemical properties which can generally be traced back to the rearrangement taking place in the chemical structure of the polymer as a result of energy deposition [1-5]. In the last few decades the solid state nuclear detectors has proven to be one of the most efficient, useable and recommended group of detectors available in marketing, In recent years the (SSNTD's) have wide applications such as fission, nuclear physics, space physics, the study of meteoritic and lunar sample, cosmic rays, particle accelerators and reactors, metallurgy, geology, archaeology medicine, biology and many others. 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. [6-9].

LR115 plastic detector is one of the solid state nuclear track detectors frequently used cellulose nitrate which has the basic material, that contains the element of component $(C_{12}H_{17}O_{16}N_3)_n$. In recent years the solid state nuclear track detectors (SSNTDs) have wide applications such as radon and progeny measurements [10-13]. The LR115 type film is sensitive for α-particles such that when α-particle hits the film it causes localized damage to the molecular structure of the cellulose nitrate layer. This damage can be visually observed through microscope when the exposed film is etched in a bath of diluted sodium hydroxide solution amongst other able to be counted. The holes exhibit different diameters, due to α-particles [10-14]. In most cases the amount of energy deposited in the host polymer is enough for extensive breaking of the chemical bonds within the track, which makes that strong modification of the bombarded polymer material, is possible. The energy released by the ion during slowing down is deposited in the target by means of two basically different mechanisms, electronic excitation and nuclear collision, which induce quite different processes of polymer matrix rearrangement [8,9]. The present work aims to study the effect of irradiation time and etching with 2.5N for 1 hour on some optical properties ( the absorbance, transmittance, reflectance, optical energy band gap, number of carbon atoms per conjugation length and number of carbon atoms per cluster) of LR115 polymer irradiated with alpha particles at constant energy 5MeV, but at different irradiation times.

## 2. Experimental details

### 2-1. Materials and methods

Plastic LR115 detector sheet is one of trade marks of the family of cellulose nitrate with red colored, pursed from Kodak Path-France, molecular