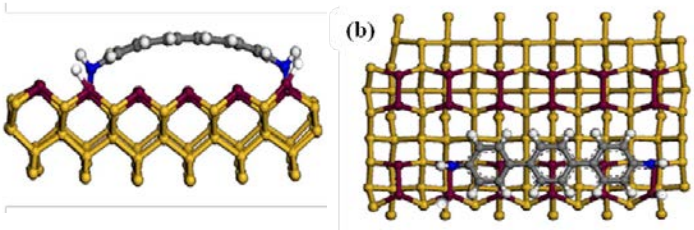
Development of Novel Scintillation Detectors

Amer Mahmoud Amer Hassan[1,2]

[1]*Laboratory of Nuclear Problems, JINR, IIO,141980, Dubna*
[2]*Reactor Physics Department, Nuclear Research Center, Egyptian Atomic Energy Authority, P.O. Box 13759, Cairo, Egypt*
amerstm@gmail.com

Nano organic molecules have attracted much of my interest to fabricate novel functional devices. Interfaces between organic semiconductors have crucial roles in determining the electronic properties of devices ranging from field-effect transistors (FETs) to photovoltaics and scintillations, which is a flash of light produced in a transparent material by an ionization event; the process of scintillation is one of luminescence whereby light of a characteristic spectrum is emitted following the absorption of radiation. Interface and fabrication an ultrathin film play important roles in the scintillation efficiency, this condition has been achieved in my study by depositing 4,4′′-diamino-p-terphenyl (DAT Figure 1(a)) on the Si (001), DAT is a good candidate for a silicon substrate. DAT has been employed for electroluminescence (EL) devices prepared by vapor deposition polymerization. So, the thicknesses of devices using DAT can be easily controlled at molecular level in the vapor polymerization process.

Fig.1. (a)



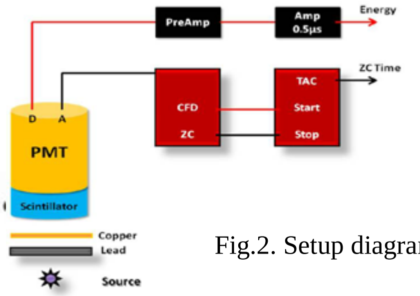


Fig.2. Setup diagram.

Organic composite scintillators such as *p*-terphenyl can be compared with the organic liquid scintillators, composites are solids and less flammable; flash point for *p*-terphenyl is 207 °C and for stilbene over than 112 °C. Composite scintillators are sensitive not only to fast neutrons, but also to γ-rays; however, the signals from these events can be well separated. The composite scintillators can also be obtained in larger diameter than organic single crystals, but they must be thin enough to achieve the performance which is the key of issue.

A simplified diagram of the setup shown in Figure 2, samples attached to photomultiplier tube PMT, the pulse shape discrimination (PSD) performed by means of a zero−crossing (ZC) method. The anode pulse as a start signal was taken by constant fraction discriminator (CFD) and a stop signal using ZC of a bipolar-shaped pulse. The time difference was registered by a time-to-amplitude converter (TAC). It is well known that various charged particles produce scintillations with different decay constants, depending on their mass and charge, which results in differences in ZC time. The large differences in amplitudes of the slow component decay time are crucial for separation of fast neutrons from γ-rays. The estimation of the number of photoelectrons per energy unit (phe/MeV) will be done by using the Compton edge of γ-rays from a 137 Cs source and a single photoelectron spectrum from the PMT. The response of the composite scintillators to fast neutrons measured by means of a neutron source. The detector shielded by 10 cm of lead to reduce the intensity of high-energy γ-rays from the neutron source and 3 mm of copper to reduce the X-rays from lead.

In conclusion, it is expected that the new material have a scintillation properties in addition to use fascinating molecular characteristics, compact, light and environmental-friendly novel devices can be supplied at reasonable costs.