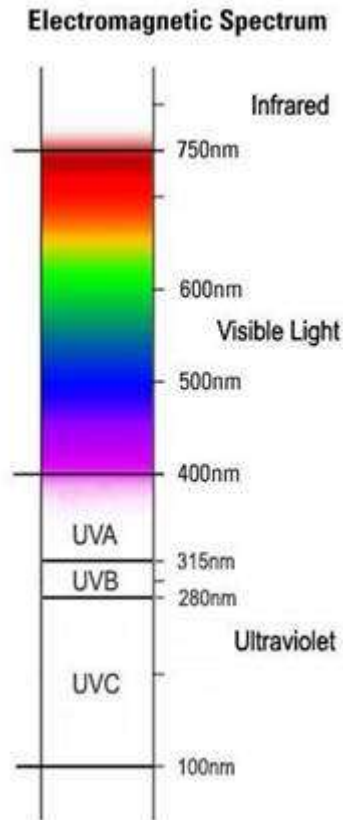


## Films



band gap GaN: 3.4 eV

$$E = \frac{hc}{\lambda}$$

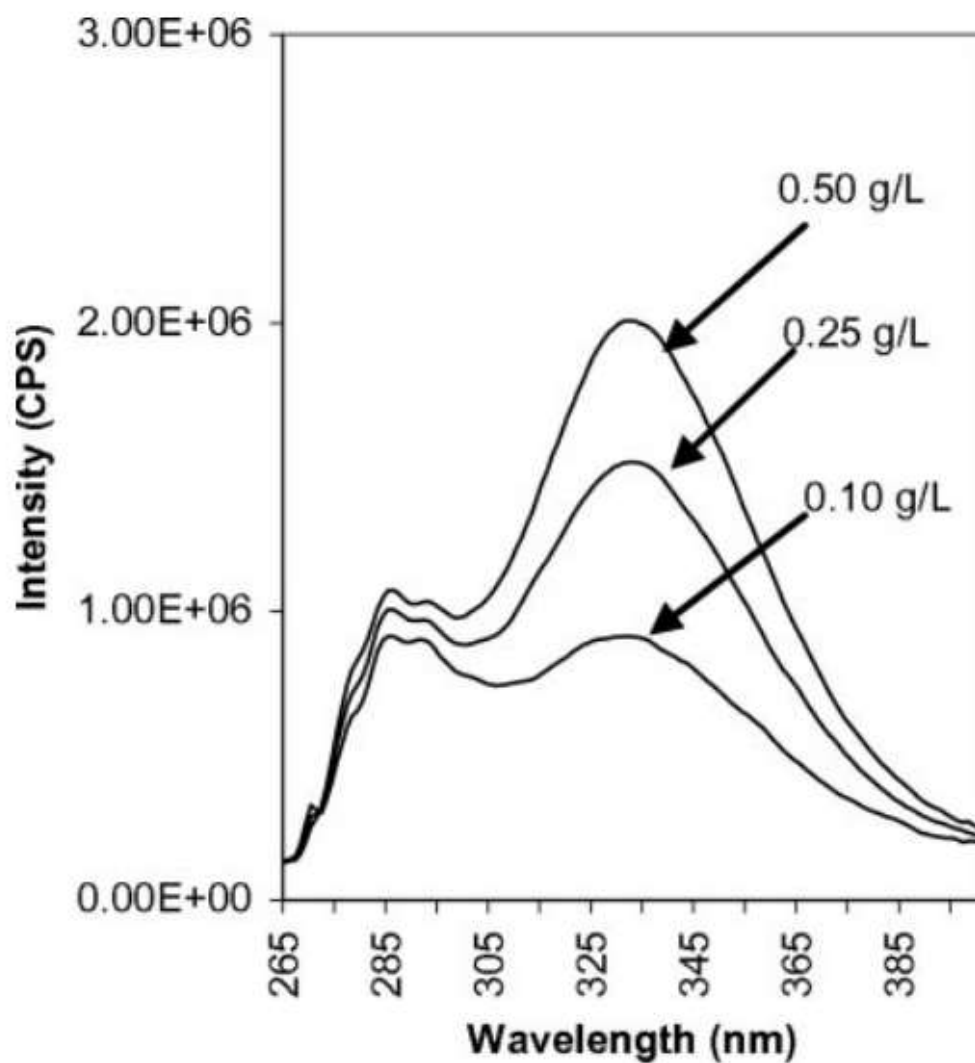
Donde  $E$  es la energía de los fotones,  $h$  y  $c$  son ambas **constantes**, la  $e$  es la carga del electrón.

Para encontrar la energía de los fotones:

$$E(eV) = \frac{1.2398}{\lambda(\mu m)}$$

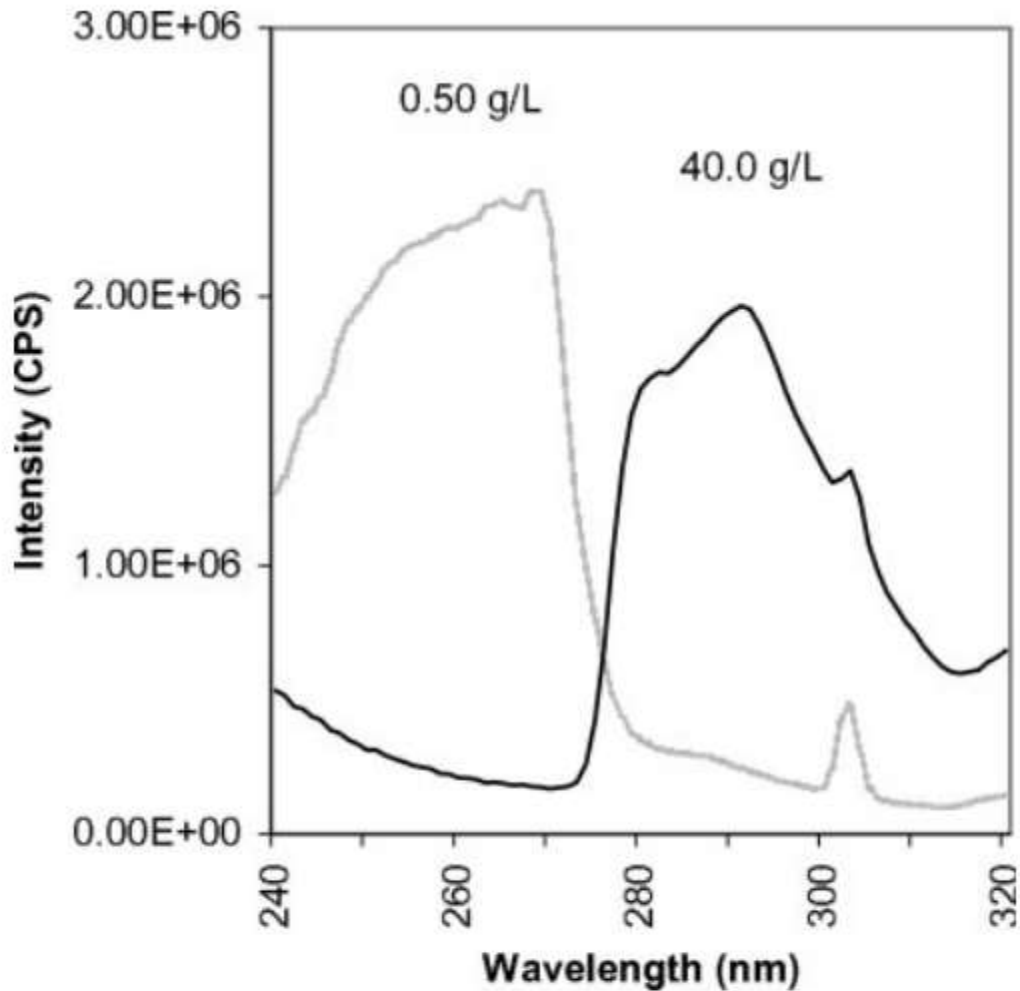
1 NANOMETRO = 0.001 MICROMETRO

$$E(eV) = 1240 / \lambda(nm)$$



**Figure 1** Fluorescence **emission** spectra of polystyrene ( $\bar{M}_w = 223,200$ ) at three concentrations in decalin at 20°C (excitation at 250 nm). The band at 285 nm is the fluorescence due to polystyrene monomer, while the band at 332 nm is due to polystyrene excimer.

$$E = 1240 / 335 = 3.7 \text{ eV re bien}$$

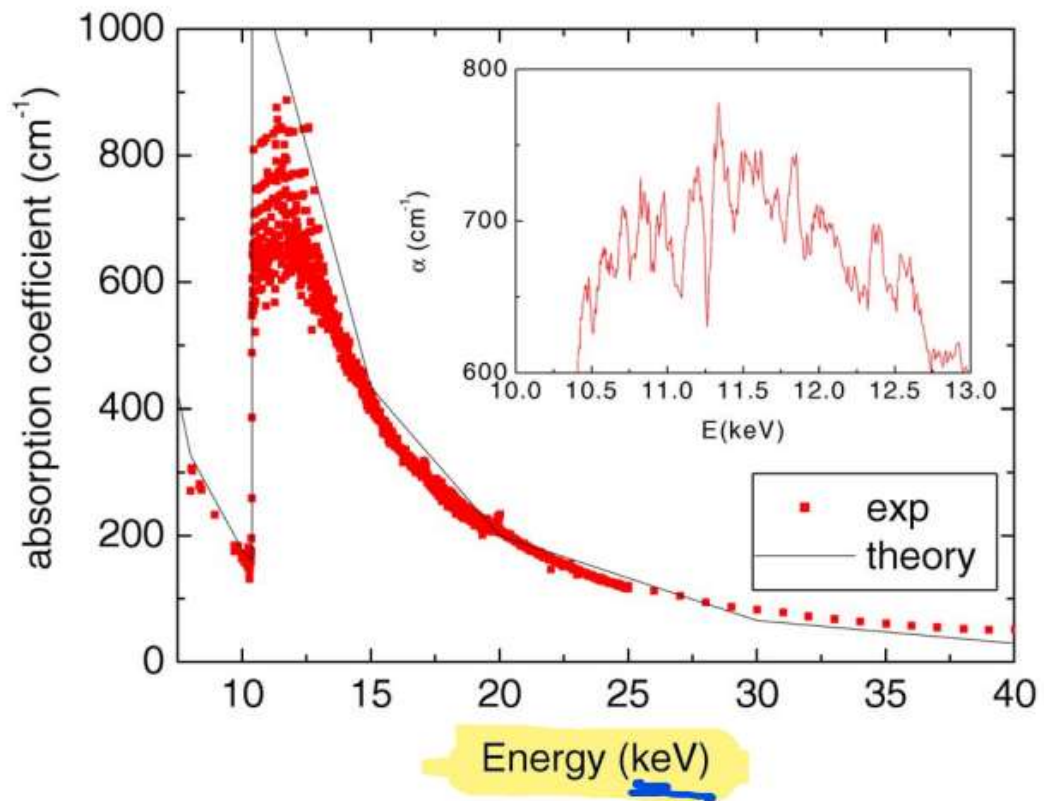


**Figure 2** Fluorescence **excitation** spectra of polystyrene ( $\bar{M}_w = 223,200$ ) at two concentrations in decalin at 20°C (excimer emission at 332 nm). Light line, 0.5 g/L; dark line, 40 g/L. The band at 291 nm in the 40 g/L spectrum is assigned to complex formation. The relatively sharp peak at 304 nm is from Raman scattering.

los rayos X van de  $10^{-8}$  a  $10^{-10}$  m === 10 a 0,01 nanómetros

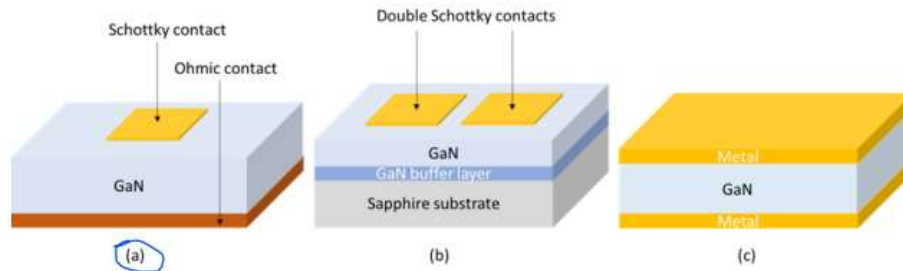
$E(\text{eV}) = 1240 / \lambda(\text{nm}) = \text{de } 124 \text{ eV a } 124 \text{ keV}$

absorción de GaN para fotones ...



nos estaria faltando capturas los mas energeticos

PARTICULAS ALFA

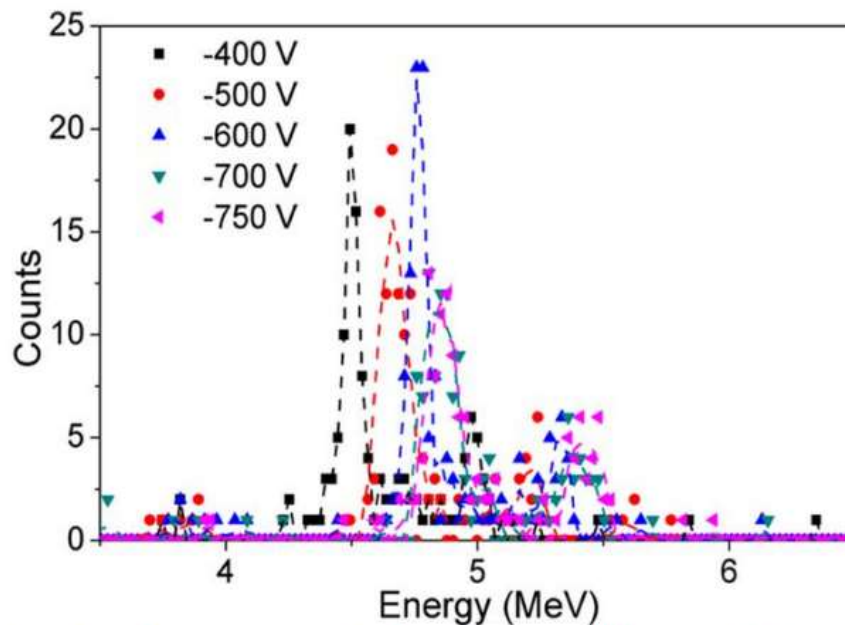


**Figure 5.** Schemes of the typical GaN devices used for the detection of alpha particles and neutrons, (a) SBD, (b) double SBD, and (c) MSM. Figure adapted from Ref. [5].

### 3.1. Radiation response to alpha particles and neutrons

The pioneering work on alpha particle detection was done by Vaikuts et al. [46]. They have achieved charge collection efficiency (CCE) of 92% for 5.84 MeV alpha particles ( $^{241}\text{Am}$  source) using the double SBD as shown in Fig. 5b. Additionally, Muligan et al. [47] have fabricated GaN SBDs (as shown in Fig. 5a) for measuring the response for alpha particles ( $^{241}\text{Am}$  source). They have obtained excellent results and a charge collection efficiency of 100 %.

Figure 6 shows the radiation response to alpha particles obtained by GaN SBD at different voltages (from -400 up to -750 V) in a vacuum. CCE of 100% for 5.48 MeV alpha particles was achieved at -750 V [48].



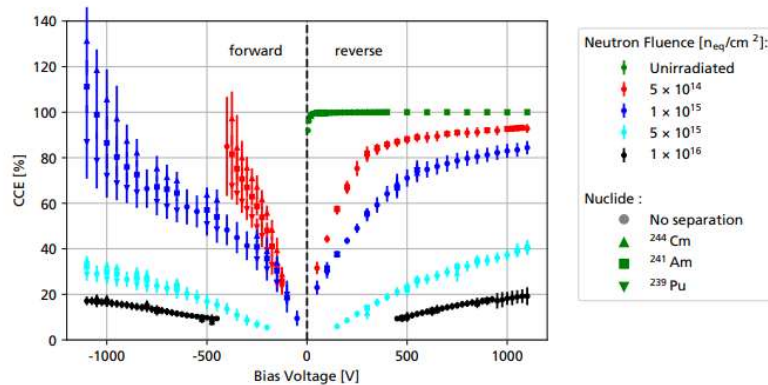
**Figure 6.** Radiation response of GaN SBD to alpha particles ( $^{241}\text{Am}$  source) at different voltages in vacuum. Data taken from Ref. [48].

CCE = charge collection efficiency

$$CCE = \frac{Q_{meas}}{Q_{gen}} \quad (21)$$

### 3.2.1 Alpha Particles

Figure 3 shows the measured charge collection efficiency as a function of forward and reverse bias for different neutron fluences. In reverse bias, charge collection efficiencies above 80 % can be



**Figure 3:** Charge collection for alpha particles in forward and reverse bias. The CCE has been normalized to each of the three isotopes present in the source where possible.

esto es para SiC (3.24 eV de bandagap)

---

Un ejemplo común de centellador que absorbe partículas alfa y emite luz ultravioleta es el centellador de plástico. Este tipo de centellador está compuesto por un material plástico, como el poliestireno o el polimetilmetacrilato (PMMA), que contiene átomos de hidrógeno y carbono.

Cuando una partícula alfa penetra en el centellador de plástico, interactúa con los átomos de carbono y libera electrones de baja energía. Estos electrones excitados pueden transferir su energía a los átomos de carbono y hacer que emitan fotones de luz ultravioleta. Esta luz ultravioleta puede ser detectada por un fotomultiplicador o un detector de fotodiodos, lo que permite la detección y el análisis de las partículas alfa.

Otro ejemplo son los centelladores orgánicos líquidos, como el xililbifenilo (PBD) y el 2,5-difeniloxazol (PPO), que también pueden absorber partículas alfa y emitir luz ultravioleta. Estos centelladores se utilizan en detectores de partículas alfa líquidos y ofrecen una alta eficiencia de detección.

----

#### PROPERTIES OF CSI(Tl) SCINTILLATORS

Density (g/cm <sup>3</sup> )	4.51
Melting point (K)	894
Thermal expansion coefficient (C <sup>-1</sup> )	54 x 10 <sup>-6</sup>
Cleavage plane	None
Hardness (Mohs)	2
Hygroscopic	Slightly
Wavelength of emission max. (nm)	550
Lower wavelength cutoff (nm)	320
Refractive index @ emission max	1.79
Primary decay time (ns)	1000
Light yield (photons/keV)	54
Photoelectron yield (% of NaI(Tl)) (for γ-rays)	45

#### PROPERTIES OF CSI(Na) SCINTILLATORS

Density (g/cm <sup>3</sup> )	4.51
Melting point (K)	894
Thermal expansion coefficient (C <sup>-1</sup> )	54 x 10 <sup>-6</sup>
Cleavage plane	none
Hardness (Mohs)	2
Hygroscopic	Yes
Wavelength of emission max. (nm)	420
Lower wavelength cutoff (nm)	300
Refractive index @ emission max	1.84
Primary decay time (ns)	630
Light yield (photons/keV)	41
Photoelectron yield (% of NaI(Tl)) (for γ-rays)	85

## ABSORCION DEL POLIESTIRENO



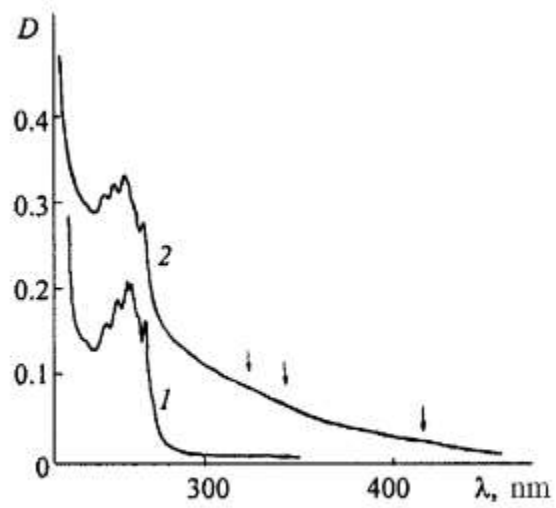


Fig. 3 Absorption spectra of polystyrene (PS) solutions in cyclohexane: original (1). S-600 (2).

los rayos X van de  $10^{-8}$  a  $10^{-10}$  m === 10 a 0,01 nanómetros

$E(\text{eV}) = 1240 / \lambda(\text{nm}) = \text{de } 124 \text{ eV a } 124 \text{ keV}$

EMISIONES DEL POLIESTIRENO CON DISTINTOS LAMBDA INCIDENTES



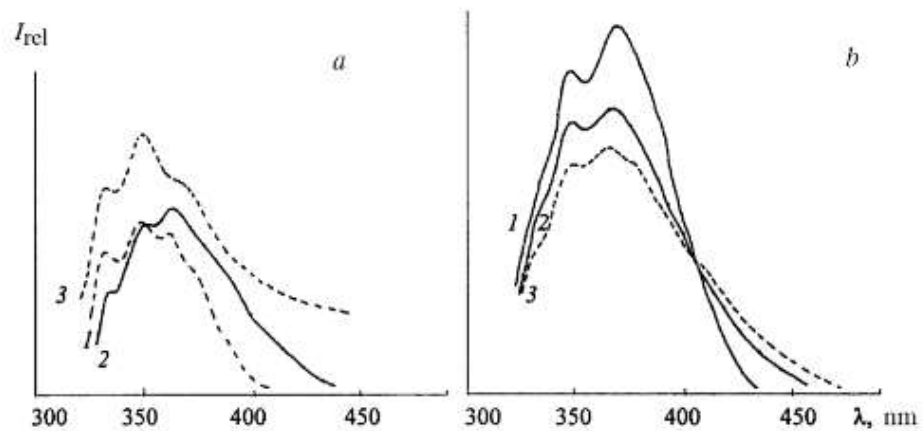


Fig. 1 Fluorescence spectra ( $\lambda_{\text{ex}} = 310$  nm): a) F-30 (1), F-60 (2), *trans*-stilbene in cyclohexane (3); b) S-150 (1), S-300 (2), S-600 (3).

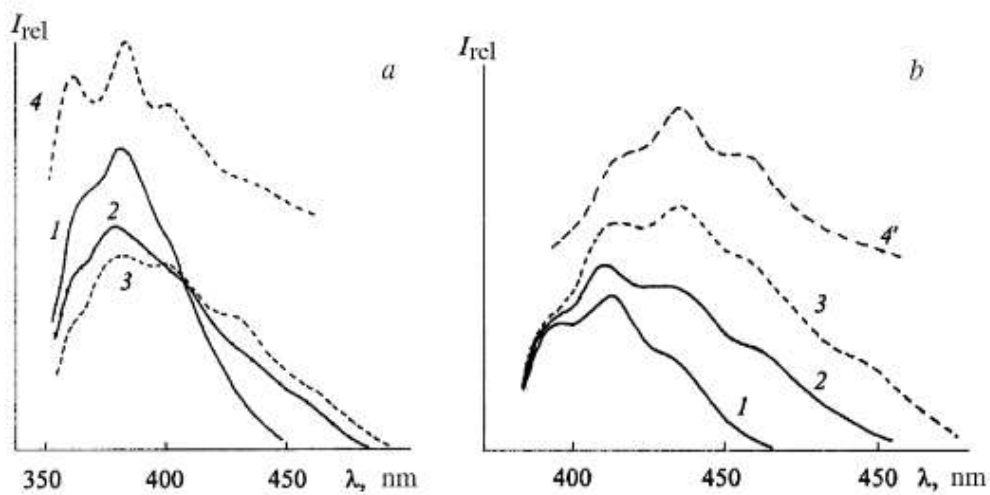


Fig. 2 Fluorescence spectra of S-150 (1), S-300 (2), S-600 (3), solution of diphenylbutadiene (DPBD) in cyclohexane (4), solution of DPBG in cyclohexane (4');  $\lambda_{\text{ex}} = 340$  nm (a) and 365 nm (b).

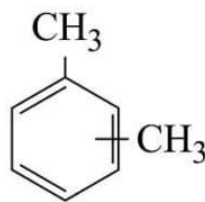
# Hidrocarburos aromáticos



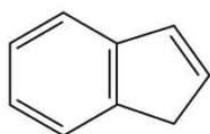
Benceno



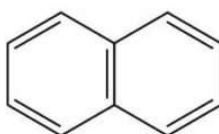
Tolueno



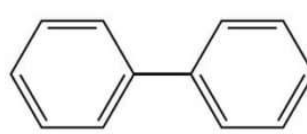
O-, M-, P-Xileno



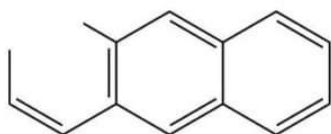
Indeno



Naftaleno

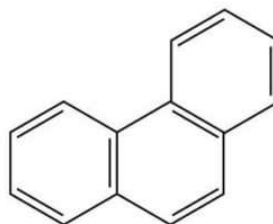


Bifenilo



 lifeder.com

Antraceno



Fenantreno

Los compuestos aromáticos son aquellos compuestos químicos (más comúnmente orgánicos) que contienen uno o más anillos con electrones pi deslocalizados alrededor de ellos.

El benceno,  $C_6H_6$ , es el hidrocarburo aromático menos complejo y fue el primero en ser nombrado como tal. La naturaleza de su vínculo fue reconocida por primera vez por August Kekulé en el xix. Cada átomo de carbono en el ciclo hexagonal tiene cuatro electrones para compartir. Uno va al átomo de hidrógeno y otro a cada uno de los dos carbonos vecinos. Esto deja un electrón para compartir con uno de los dos átomos de carbono vecinos, creando así un doble enlace con un carbono y dejando un enlace sencillo con el otro, razón por la cual algunas representaciones de la molécula de benceno lo describen como un hexágono con alternancia simple y dobles enlaces.

Otras representaciones de la estructura muestran el hexágono con un círculo en su interior, para indicar que los seis electrones están flotando en orbitales moleculares deslocalizados del tamaño del anillo en sí. Esto representa la naturaleza equivalente de

los seis enlaces carbono-carbono, todos de orden de enlace 1,5; la equivalencia se explica por formas de resonancia. Los electrones se visualizan flotando por encima y por debajo del anillo, y los campos electromagnéticos que generan actúan para mantener el anillo plano.



v/v».

$$\% \text{ volumen} = \frac{\text{volumen de soluto (ml)}}{\text{volumen de disolución (ml)}} \cdot 100$$

$$\% \text{ m/v} = \frac{\text{masa de soluto (g)}}{\text{volumen de disolución (ml)}} \cdot 100$$

$$\% \text{ masa} = \frac{\text{masa del soluto (g)}}{\text{masa de disolución (g)}} \cdot 100$$

Molaridad:

$$M = \frac{\text{moles de soluto (n)}}{\text{volumen de solución (L)}}$$

**Miercoles 17/4/24**



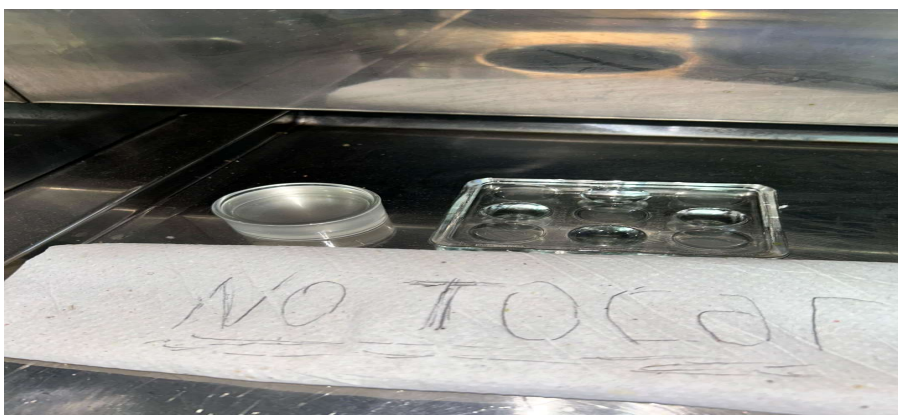
Primera muestra (izq) realizada con 1.0138g de telgopor y un aproximado de 8 ml de tolueno.

segunda muestra (der.) realizada con 2.104g de telgopor y 15 ml de tolueno.

En teoria las mezclas son por cada gramo de telgopor 5.77 ml de tolueno, pero si veiamos que quedaban grumitos de telgopor agregabamos mas hasta que desaparecian.

### **Viernes 19/4/24**

Armamos soluciones de 6.0204g de telgopor con 38 ml de tolueno y las dispusimos en distintos frascos para obtener centelladores de más tamaños



del paper Cef3\_ppo\_pvt

### 2.1. Preparation of CeF<sub>3</sub> nanoparticles loaded PPO/PVT composites

All the chemicals utilized in this work were analytic grade and employed without further purification. Firstly, 2 g of PVT and PPO were dissolved in 20 ml of toluene. The mixture was stirred for 15 min at room temperature. The different amounts of CeF<sub>3</sub> nanoparticles (2, 4, 6, 8, and 10 mg) were added into the above mixture and continuously stirred for 1 h at room temperature. The mixtures were transferred in a petri dish and annealed in an oven at 50 ° C for 5 days.

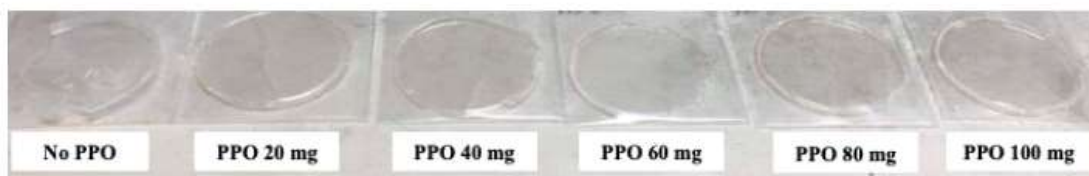


Fig. 1. Prepared PVT/PPO composites.

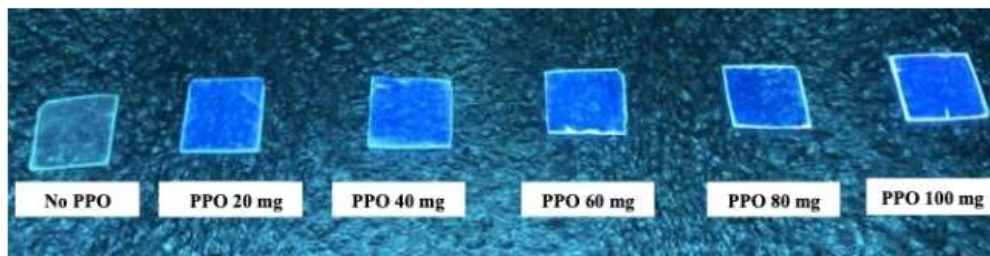


Fig. 2. The bluish light is emitting under the UV light of the plastic. PVT/PPO composites.

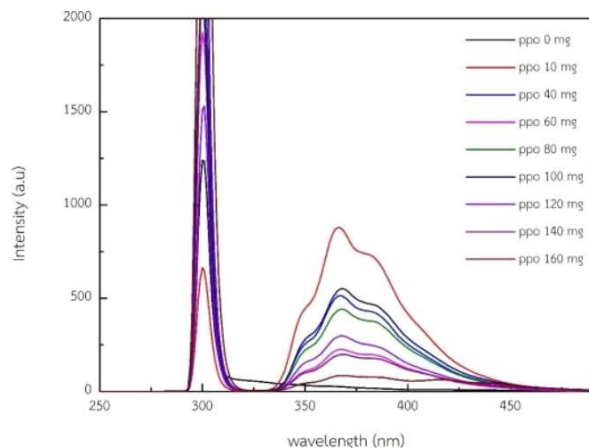
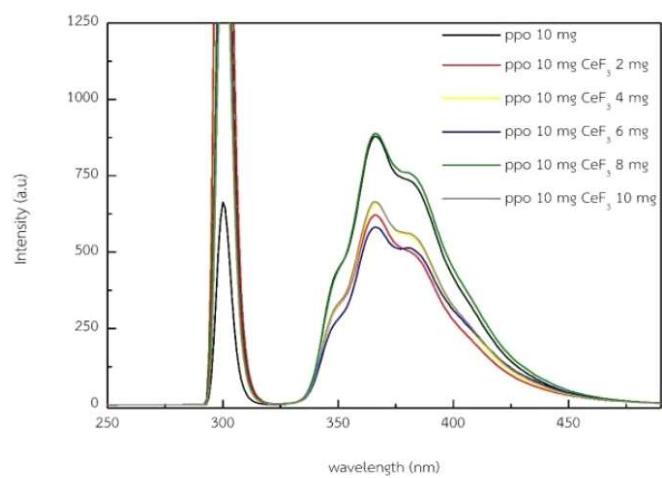


Fig. 3 shows the prepared sample spectrum as measured with a fluorescence spectrophotometer using an excitation wavelength of 300 nm. The figure shows that the sample without PPO was not luminous, and when the PPO was added, it emits light at a wavelength of 366 nm in all samples. PVT added with a PPO at a dosage of 10 mg had the highest emitting intensity.

y ahora agregando cef3

Various content of  $\text{CeF}_3$  nanoparticles was loaded into the PVT matrix while the PPO concentration has been maintained at 10 mg. Compared to the unloaded sample, PPO/PVT composites loaded with  $\text{CeF}_3$  nanoparticles exhibited brighter emissions under UV light, as shown in Fig. 4.  $\text{CeF}_3$  nanoparticles greatly improved the photoluminescence of PPO/PVT composites. As expected, this increase in the emission intensity of nanocomposites loaded with  $\text{CeF}_3$  nanoparticles is due to the transfer of energy from  $\text{CeF}_3$  to PPO in the PVT matrix. Besides, when excited at 300 nm wavelengths, the  $\text{CeF}_3$  nanoparticles loaded PPO/PVT composites' photoluminescence spectra do not reveal any emissions from  $\text{CeF}_3$  nanoparticles. Since the  $\text{CeF}_3$  emission perfectly overlaps with PPO absorption in PVT, nanoparticles excitation will transfer their energy to PPO in the PVT matrix [6].





PAPER CEF3 PPO PVT 2

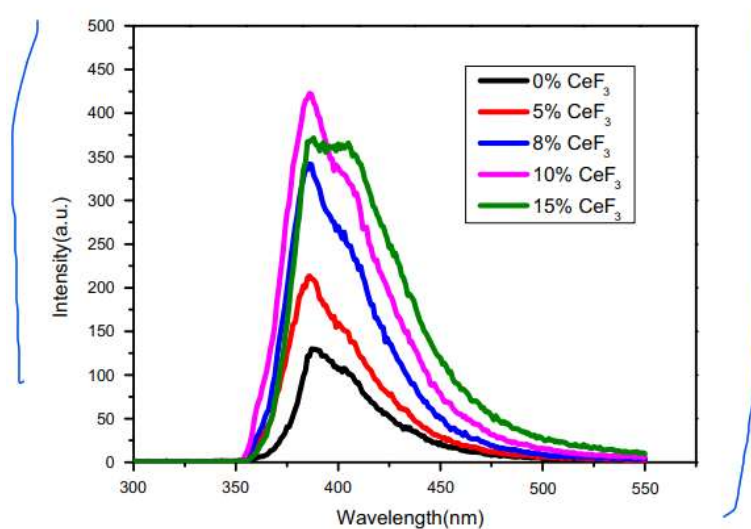


In this work,  $\text{CeF}_3$  nanoparticles were synthesized via a precipitation reaction. Briefly, 30 mmol sodium fluoride (NaF) was dissolved into 80 mL of D.I water and mixed with 80 mL of ethanol solution containing 1.5 mL oleic acid. The mixture was heated to  $80^\circ\text{C}$  under vigorous stirring with purging of argon gas. 10 mmol of  $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$  was then dissolved into 60 mL of DI water and added into the above mixture dropwise. The reaction was kept as  $80^\circ\text{C}$  for 4 h and then allowed to cool in the air. The precipitates were collected by centrifugation and washing with ethanol for three times and then dried at  $50^\circ\text{C}$  for 12 h under vacuum.

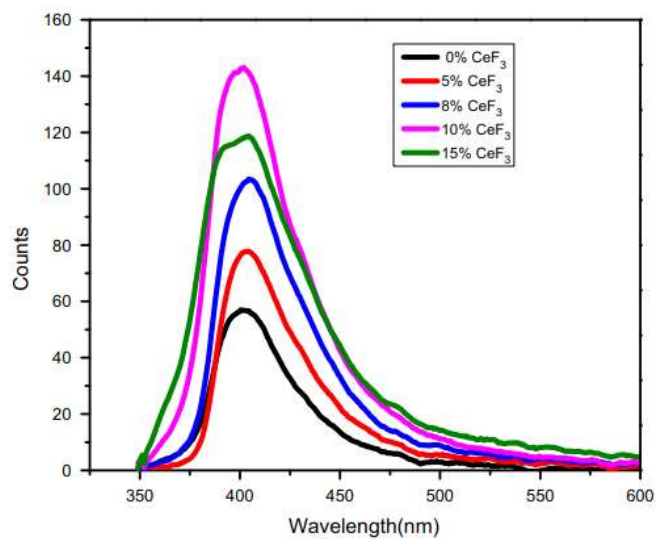
### 2.3. Preparation of $\text{CeF}_3/\text{PPO}/\text{PVT}$ nanocomposites

After removal of the polymerization inhibitor from PVT monomers using a silica column, benzoyl peroxide (as the free radical initiator) (0.1 wt%) and PPO (0.5 wt%) were dissolved in PVT monomer solution and subjected to ultrasonication for 20 min. Then, different concentrations (wt%) of  $\text{CeF}_3$  nanoparticles were added into the above mixture and further sonicated for 45 min. During the first 45 min of the incubation process at  $75^\circ\text{C}$ , the  $\text{CeF}_3$  nanoparticle-contained PVT monomer solution was agitated with vortex mixture for several times to ensure a good dispersion of  $\text{CeF}_3$  nanoparticles in the monomer. After these treatments, the polymerization of PVT monomers has been sufficiently initiated so that the enhanced viscosity would prevent  $\text{CeF}_3$  nanoparticles from aggregation. The composite was then allowed to be incubated at  $75^\circ\text{C}$  for 90 h and

then cooled down to room temperature. Free-standing  $\text{CeF}_3/\text{PPO}/\text{PVT}$  composites were then obtained after removing the glass container.



**Fig. 5.** Photoluminescence of PPO/PVT with different loading concentrations of  $\text{CeF}_3$  nanoparticles.



**Fig. 7.** XEOL of PPO/PVT with different loading concentrations of  $\text{CeF}_3$  nanoparticles.

wt% means weight percent which is sometimes written as w/w i.e. [ weight of solute/ weight of solvent\*100 = percent of solute in the solution].

#### 4. Conclusion

CeF<sub>3</sub> nanoparticles were synthesized and their emission is at 330 nm which is mainly from surface states. Enhanced luminescence is observed in PPO/PVT scintillators when embedded with CeF<sub>3</sub> nanoparticles. Enhancement in the PL is more than 3 times for 10 wt% of CeF<sub>3</sub> loading whereas enhancement is 2.5 times when X-ray is used as excitation source for the same nanoparticles loading concentration. The luminescence enhancement in PPO/PVT by CeF<sub>3</sub> nanoparticles is attributed to the energy transfer, the increase of the stopping power by doping CeF<sub>3</sub> nanoparticles as well as the escape of charges from CeF<sub>3</sub> nanoparticles. The observations provide a new method to improve PPO/PVT organic scintillators for radiation detection.