Detector basics (7/11)

Scintillator

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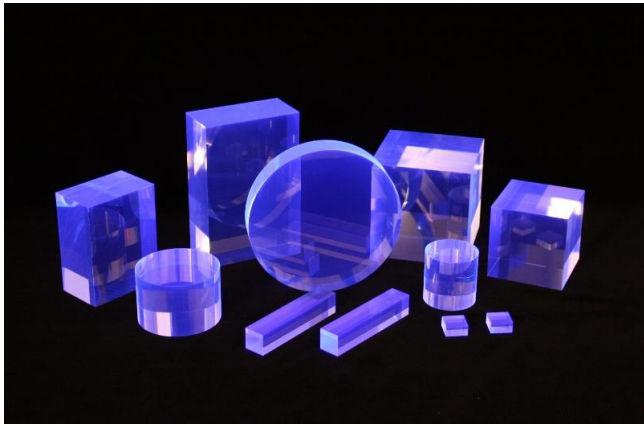
Plastic scintillator

Most widely used class of Sci.

- Made from a suitable polimerisable liquid. (Styrene, Vinyltoluene etc)
- The base material in sci emit UV light, so we need to add WLS or fluor.
- The flour absorb primary UV and emit a longer wavelength light.



Example of Scintillator (eljen)
https://eljentechnology.com/products/plastic-scintillators/ej-200-ej-204-ej-208-ej-212

Plastic scintillator

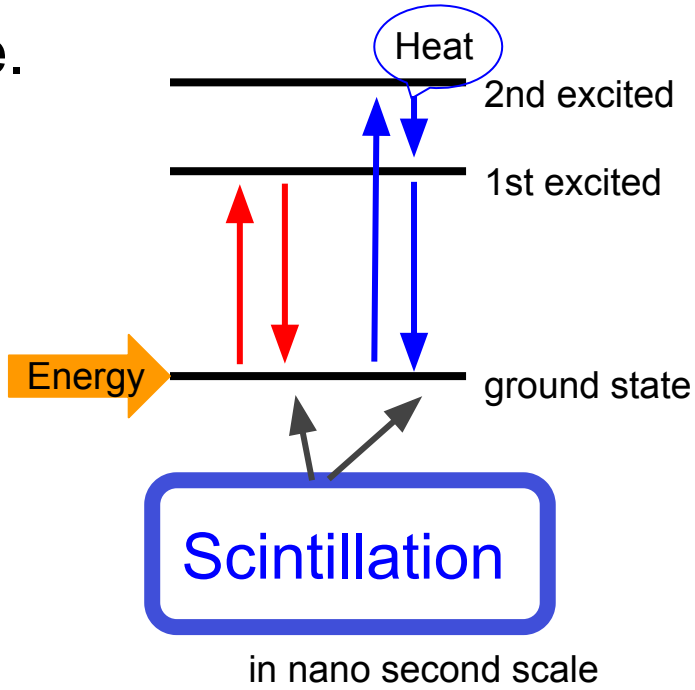
- It can be easily produced and shaped into whatever shape is required. (sheet, fibre ...etc)

Table 6.1 Properties of the plastic scintillator Kowaglass SCSN-32

Plastic type	Polystyrene-based scintillator
Light yield	8,000 photons/MeV, i.e. ≈16,000 photons/cm for minimum ionising particles
Decay time	3.6 ns
Emission wavelength	423 nm
Light attenuation length at 423 nm	250 cm
Optical refractive index	1.58
Density	1.08
Radiation length	30 cm

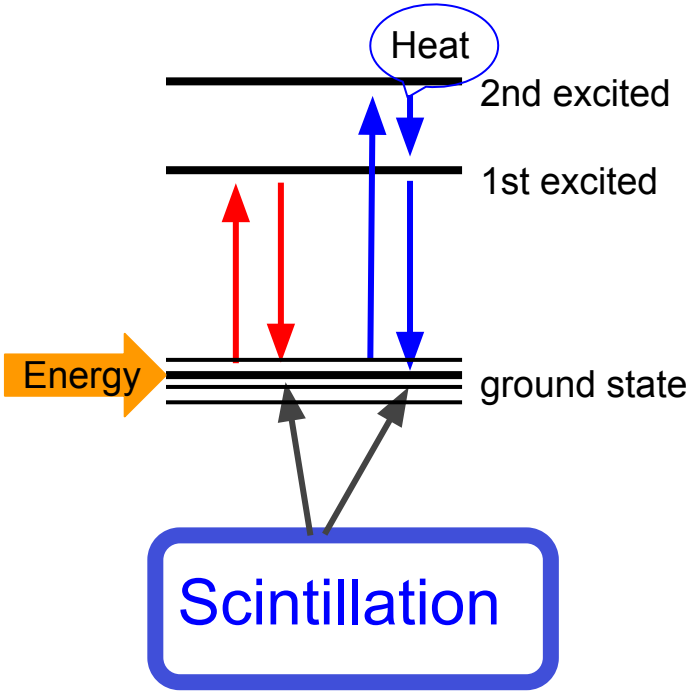
Principle

- At first, all molecules of material are at ground state in room temperature.
- Get some energy in some way and emit scintillation light when the molecules go back to ground state.
- There are the molecules which go up to 2nd excited state, but they will go down to 1st excited state in few ns with heat.



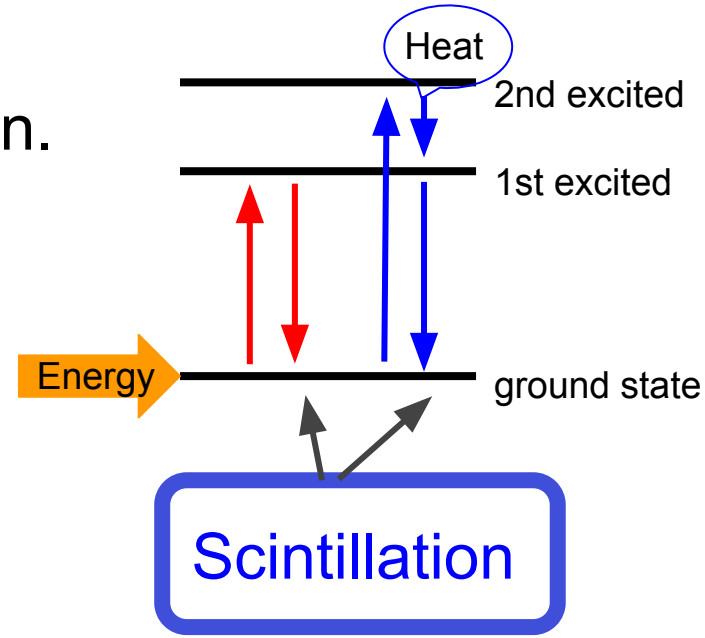
Principle

- There is a energy level oscillation in the ground state.
- we can see a spread of wavelength of emitted scintillation light.



Principle

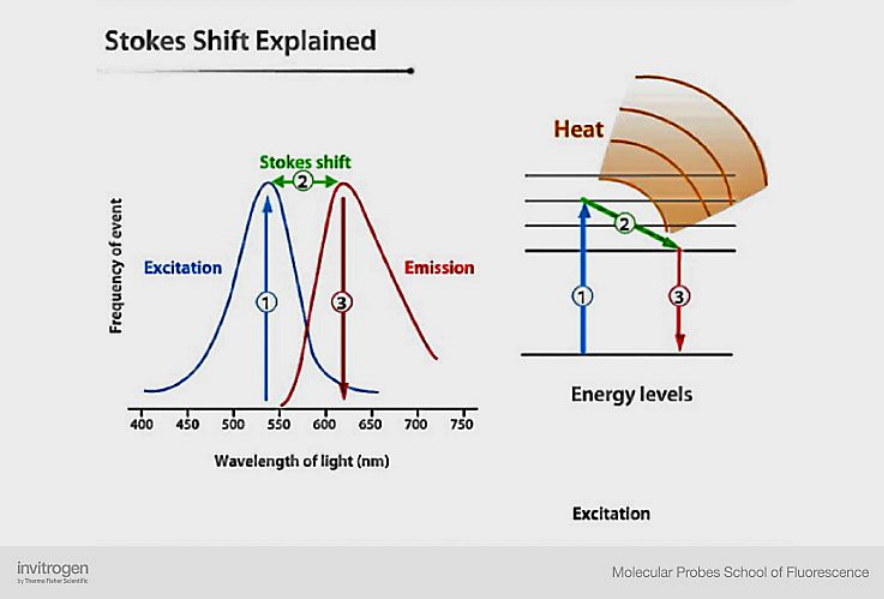
- The efficiency of scintillation is defined by the ratio of a conversion of a energy to a light in visible region.
- There is a mode without photon emission, this is so-called “Quenching” .
- In case of a liquid sci, oxygen is the cause of it.
  - to avoid this, some method are used. (Filtering, Distillation … etc)



Stokes shift

- There is a gap between the absorbed energy and a energy of emitted light.
  - Because the absorbed energy give rise to a oscillation of the molecules in material.

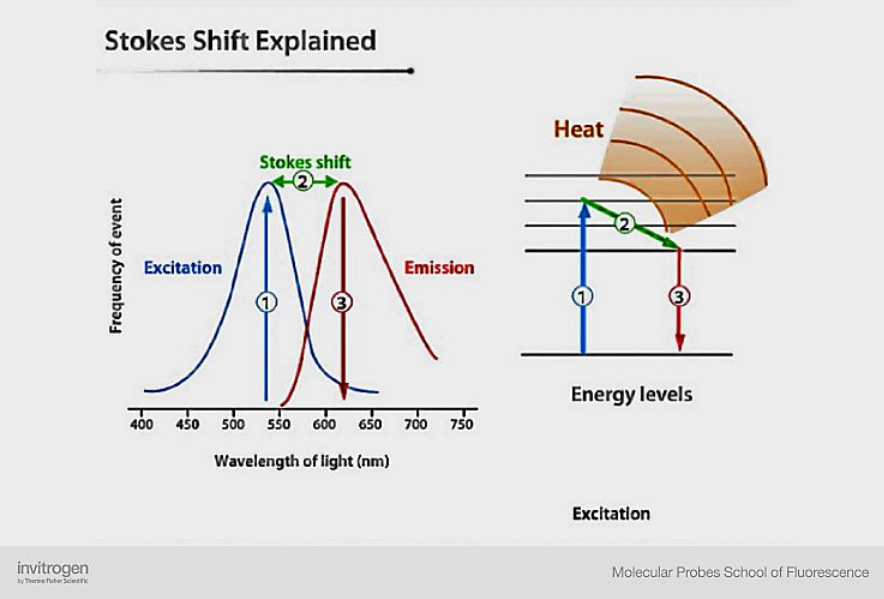
- Larger stokes shift is good for the transmittance.



https://www.thermofisher.com/jp/ja/home/life-science/cell-analysis/cell-analysis-learning-center/molecular-probes-school-of-fluorescence/fluorescence-basics/anatomy-fluorescence-spectra.html

Stokes shift

- In a physical experiment,
  what we want to know is the
  energy of the incident particle
  or there was a particle or not etc .
  - But in biology, its not.



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Presentation schedule

Today : Plastic Scintillator

Next : The main application of Organic sci & Inorganic sci

- Light guide
- Photon detection (include amplification of signals from photon.)

Reference

Experimental Techniques in Nuclear and Particle physics.
Stefaan Tavernier

シンチレータの原理と応用例　　飯田崇史（筑波大）
http://www.lowbg.org/ugnd/workshop/groupC/sn20180108/files/0901_Iida.pdf

蛍光スペクトル解剖学（Thermo Fisher SCIENTIFIC)
https://www.thermofisher.com/jp/ja/home/life-science/cell-analysis/cell-analysis-learning-center/molecular-probes-school-of-fluorescence/fluorescence-basics/anatomy-fluorescence-spectra.html