14.DyeTech2

Thursday, April 11, 2013
3:55 PM

Last time, talked about dyes:
1) Don't disturb flow
2) High visibility: consider Big 4: Refraction, reflection, diffraction, absorption.
Choose lighting and background accordingly

3) Special Techniques

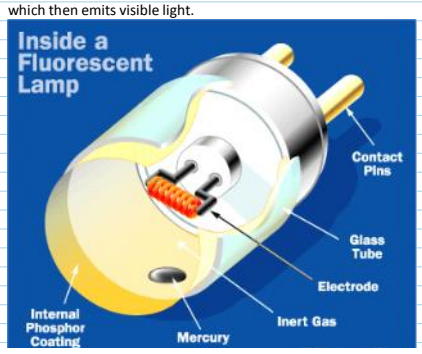
Light Emitting fluids

Black Body Radiation = yellow flame color, from BBR of soot particles. Random λ (wavelength) photons from thermal energy

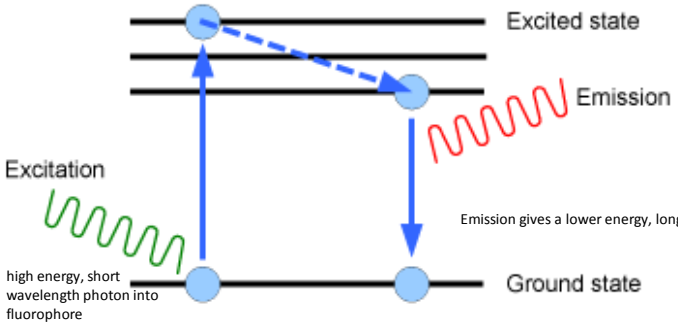
Luminescence = cold body emission, usually at specific λ.
Fluorescence = absorb at a specific short λ, emit at a longer λ.

E.g. some laundry detergents and fabric softeners absorb in the UV, and emit blue or orange

Fluorescent bulbs: Current is conducted through mercury vapor, energizes it to emit UV photons which hit a phosphor coating on the inside of the tube, which then emits visible light.



http://home.howstuffworks.com/fluorescent-lamp.htm/



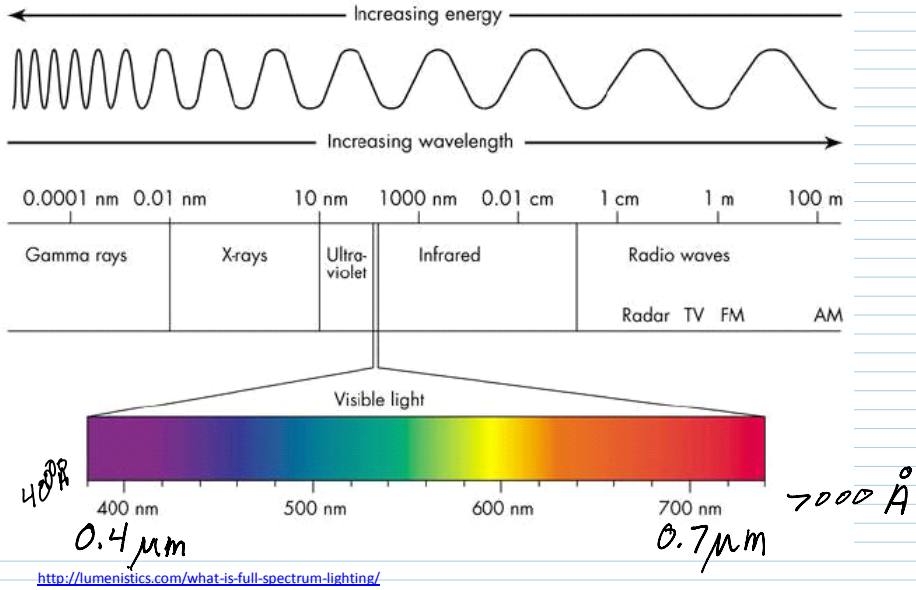
Emission gives a lower energy, longer wavelength photon.

high energy, short wavelength photon into fluorophore

http://www.art.ca/en/preclinical/optical-molecular-imaging/fluorescence.php

Wavelength change = Stokes shift: some heat lost from excited state, and/or returns to ground state + highest vibrational mode, not all the way down.

EM spectrum review



http://lumenistics.com/what-is-full-spectrum-lighting/

Chemoluminescence - Cyalume: chemical reaction releases photon, which then drives fluorescence. Needs mix of chemicals for reaction, and choice of color.
Flames: C_2, CH^*, radicals = highly reactive intermediate molecules (between reactant and product species) that only exist in the thin reaction zone. Excited by reactions, emit blue photons to get to lower energy state. Also, hot soot gives off black body radiation; yellow glow.
Bioluminescence - Fireflies, deep sea fish, worms. Good for flow vis?

Electroluminescence - LEDs, sodium vapor, mercury vapor lamps etc. Specific λ.
E.g. electric pickle http://www.youtube.com/watch?v=tMhXCG6k6oA

Laser : population inversion, specific λ, resonant cavity with mirrors. Gas dynamic laser: after supersonic expansion, lower vibrational states relax before higher ones = inversion. A type of 'chemical laser'