Nano2Fun Dissemination Package

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Hands-on Light Experiments

Light and Colors

a. Materials
   - Visible light source
   - Dispersion element (grating or prism)
   - Colored glasses (photographic lenses, for example)

b. Discussion

   In this experiment, we demonstrate that white light is constituted by different colors (the rainbow colors), and that a colored substance absorbs the corresponding complementary color.

c. Procedure

   Illuminate the dispersion element with the light source: the white light will separate in the rainbow colors, that can be projected on a screen. This is the direct proof that white light is the sum of all colors.

   Now place a colored glass between the light source and the dispersion element (or just after the dispersion element). The light projected on the screen will now not contain the complementary color of the filter (e.g. if the filter is yellow, the projected light will not show the violet component). This means that the color of a substance (in this case the colored glass) is determined by the portion of the light spectrum that it absorbs.

Fluorescence and Phosphorescence

a. Materials
   - Tonic Water
   - Detergent whitener
   - Clock that illuminates in the dark
   - Toys that illuminate in the dark
   - UV Lamp

b. Discussion

   The experiment shows that some materials emit light after excitation. Emission can be distinguished into fluorescence and phosphorescence, according to the prototypical lifetime of the process. Phosphorescence is a long process: it continues for seconds, or minutes, or hours after the excitation source is switched off. Fluorescence is very short: it turns off in some (hundreds of) nanoseconds so that it cannot be seen after the excitation source is switched off.

c. Procedure

   Illuminate (i.e. excite) the luminescent materials with the UV-lamp: they will emit light. Turn off the light: some of them will continue emitting light (phosphorescent materials), while emitted light of the other is turned off in the absence of excitation (fluorescent materials).

Separation of pigments in the mint syrup

a. Materials
  - mint syrup containing the two pigments tartrazine and patent blue
  - Pasteur pipette
  - cotton
  - 3 vials
  - spoon
  - silica
  - water
  - ethanol
  - optional: UV-Vis spectrophotometer

a. Discussion

The experiment proves that the mint syrup is green due to the presence two dyes, that can be easily separated using a chromatographic technique. Chromatography is a physical method for separation, and it is based on the different affinities of the analytes with the stationary phase (in our case silica) and the mobile phase (here water and ethanol), called eluent. In other words, if the product "prefers" the solid, it stays long within the column. On the opposite, if the product prefers the liquid, it goes more rapidly out of the column.

b. Procedure

-preparation of the chromatographic column: Place a small piece of cotton at the bottom of a Pasteur pipette. Mix one spoon of silica with water, pour the suspension in the pipette and place one vial at the bottom of the pipette to collect the water.
-separation of the dyes: When water reaches the column level, add 2-3 drops of mint syrup. Add water, and when the first dye reaches the bottom of the column, collect the colored solution in a vial. Add ethanol and collect the second dye in another vial.

Optional: Collect the absorption spectra of the mint syrup and of the two separated dyes.

Invisible Objects-Refractive Index

a. Materials:
  - Two beakers (glassware) of different size
  - Sunflower oil

b. Discussion:

This experiment is based on the optical phenomenon of Refraction and helps to understand the concept of Refractive Index. Refraction is the change in direction of a wave due to a change in its transmission medium. When light travels through different materials, it has different direction in the two media, according to their Refractive Indexes. This effect allows us to discern the transparent materials. Sunflower oil and fireproof glassware have the same Refractive Index. When light passes through the glass and the oil, it is not refracted. As a result, we cannot distinguish glass from oil.

c. Procedure:

Place the small beaker into the big one, with the same direction. Full the small beaker with sunflower oil and continue to fill it, till the glass is totally covered. The small glass then becomes invisible.

Scattering of light: the color of the sky

a. Materials:
  - While light source (cool type, not yellowish)
  - Big transparent tank (at least 30 cm large)
  - Water
  - Milk
  - Spoon

b. Discussion:

   When light encounters small molecules or bigger particles (such as macromolecules, powder, small drops, and so on) it is typically scattered in all the direction. But short-wavelength light is scattered more efficiently than long-wavelength light is. This is the reason why the sky normally appears as blue: blue light (short wavelength) is scattered more by the atmosphere than shorter-wavelength light, so that it diffuses everywhere. At sun rising or sunset, things are different: in fact the sun is low at the horizon, and sun light has to travel through a thick layer of atmosphere before reaching us. Blue light is totally scattered by the first part of atmosphere and cannot reach us, while orange-red light is poorly scattered and can travel across the atmosphere and reach us: the sky at sun rise of sunset appears as orange-red.

c. Procedure:

   Fill the tank with water and show that nothing special happens when white light travels across water. Then add a few ml of milk into water and mix. Illuminate this milky water from the top and people from the side will see a bluish color. Then move the light source on one side of the tank, and let the people look at the light source through the milky water: they will see an orange-red color: an artificial sunset!
   Switch off room lights to best appreciate the phenomenon.
   Explanation: milk is a suspension of many macromolecules (lipids, proteins, and so on) in water: these macromolecules are responsible for the scattering of light. This is the reason why milk appears as white. When milk is diluted and the path of light is big (such as in the tank), we can appreciate the different scattering efficiency from short- and long-wavelength components of white light.

Games for children

Title

a. Material
b. Detailed Description

Conferences for the general public

Kick-off Partner Presentations

http://www.nano2fun.eu/events/14-nano2fun-kick-off-meeting

Marie Curie Ambassadors Activities

Nano2Fun Outreach Documents

The following documents are translated in different languages: www.nano2fun.eu/nano2fun-for-all

Writing and reading in 3D: two-photon polymerization and microscopy

We all are familiar with the concept of pixel, the smallest controllable element of a picture represented e.g. on a computer or tablet screen. The concept of voxel, as the smallest controllable volume element, sounds instead more exotic. A voxel is a small 3-dimensional object that can be defined and moved around using lasers and lenses thanks to a non-linear optical phenomenon called two-photon absorption. We can start to dream about "3D screens" where we can read and write information in 3D.

Two photons must be found in the same place at the same time for two-photon absorption, a process that requires the high light intensities (large photon concentrations) that can only be found at the focus position of a focused laser beam. Two-photon absorption then defines the voxel as a region of space so small as a cube whose edge is a million part of the edge of the liter-cube. We can "read" a voxel looking at the light emitted after two-photon excitation: 2-photon bioimaging allows us to see what happens inside biological tissues, spotting very small objects that can be reconstructed in 3D. To "write" in 3D we can use two-photon excitation to start polymerization within the voxel to produce very tiny and well-detailed objects.

Two-photon bio-imaging successfully exploits the light in the transparency window of biological tissues (red-infrared), and has already been demonstrated in vivo. Nanopolymerization has been used to grow photonic crystals as well as small and complex structure of interest for health application (nanosyringe, nanovalves…) that can easily be personalized. Bringing the two techniques from the advanced research labs towards extensive applications and towards the market requires the design and optimization of materials and methods and represents the main aim of Nano2Fun, Nanochemistry of Molecular Materials for 2-Photon Functional Applications, an ITN project funded by the EU commission with more than 3.5 M€ in the next four years.

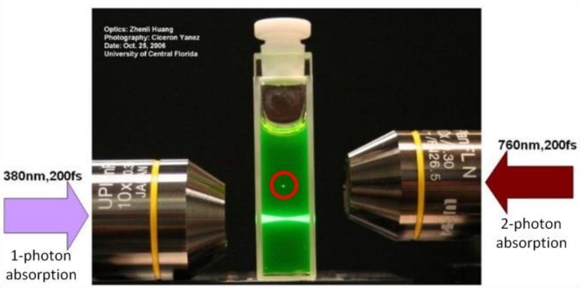

Figure (from UCF-CHEM): The one-photon (bottom of the cuvette) and two-photon absorption processes (top of the cuvette); the red circle

Innovation through research and technological transfer are the flagwords of Nano2Fun, a multidisciplinary project run by a network of 16 advanced research labs, in Universities, public and private research centers distributed in Europe, India and United States, with different expertise in molecular and supramolecular synthesis, optical spectroscopy and photophysics, theoretical modelization, and technological applications and scaling up.

The inherently multidisciplinary character of the research that spans a full range of disciplines between chemistry and physics offers an extremely profitable environment for the education through research of young researchers both in public and private sectors, in a lively international environment at the forefront of research. 17 young researchers will be hired within Nano2Fun where they will have the possibility to learn first-hand the challenging work of the scientist at the interface between advanced basic research and technological transfer. Overall the recruited scientists will work for almost 500 months in first-class research centers, equipped with advanced instrumentations. They will experience different research environments including academic laboratories, private and public research centers in Europe, India and United states. Meeting will be scheduled twice per year to discuss the research progress and to participate to thematic schools, organized for the young scientists of Nano2Fun, but open to all interested people. These schools will be devoted not just to scientific topics, but also to develop skills about scientific managment, intellectual property protection, scientific communication, ethics etc. The aim is the education to research in all its multifacted aspects: from field work Nano2Fun students will learn the importance of team-work, the benefits of multi and inter-disciplinarity and the tight an fruitful link between basic research and applications, but they will also appreciate the richness of multicultural environments and the importance of gender balance to really succeed as the new generation of scientists, educated in Europe but ready to meet the challenge of scientific research in the global world.

Figure: the kick-off meeting of Nano2Fun took place in Parma on September 19-20, 2013

Meeting that inspires

Evolution of society is impossible without scientific progress. Every day, millions of scientists around the World work to make our life safer, more comfortable and interesting. Science and technology develop thank to people, the scientists, having a very interesting and complicated work at the same time – a research work. Light and its interaction with matter, one of the most fascinating and technologically relevant research fields, was the main topic of the First Project Meeting and First Training Day of Nano2Fun project. These actions took place in Slupsk (Poland) on March 20-21, 2014.

Sixteen senior scientists active in the fields of physics and chemistry gathered in Slupsk from various European and nearby countries and nine early-stage researchers joined the group, coming from Italy, Belarus, Greece and India, to discuss the directions of Nano2Fun research as well as to exchange experiences in the fields of two-photon absorption, two-photon polymerization and spectroscopy of different molecular systems. The development of modern science and technics is impossible without close interaction between theory and experiment and without interaction between different branches of science. The meeting was a fine place where theorists and experimentalists in physics and chemistry and scientists working in industrial environment discussed a wide spectrum of problems. During the meeting senior scientists presented lectures about two-photon poliymerization, chromophores for two-photon absorption, principles of linear and nonlinear spectroscopy and fluorescence were given, and young researchers presented themselves to the group. The meeting demonstrated that science is not just useful, but also interesting. Common scientific interests are a powerful social glue, allowing people from various countries to overcome cultural and historical barriers. The enthusiasm of senior and young scientists is the inspiration to new discoveries. The conference proved that science has not borders and is open to everyone. The language of science does not need translation and science allows everyone to make his/her personal contribution to the development and progress of the mankind.

On a lighter side, the meeting offered all participants a good opportunity to get acquainted with history, culture and food of Polish Pomerania and Slupsk city in particular. Next Project Meetings will be organized in different countries (Belgium, India, Spain, Germany, France, United Kingdom and Italy) every six months: an excellent opportunity for early stage researchers to develop their scientific skills a strongly multicultural context.

Link to videos

External links

http://www.physicscentral.com/experiment/physicsquest/upload/spectra-manual.pdf