Luminescence fluorescence phosphorescence pdf

Home page | About us | News | Support | OEM | Contact us | Online Advertising by Chris Woodford. Last updated: 27 April 2020. When you wake up in the middle of the night, you're not sure where you are, there's nothing more reassuring than the bright dial of a clock. You don't have to find a light: just look at your wrist and know exactly what time it is. Watches like this glow all day-we just don't notice their ghost glow during the day. What makes them shine at night, long after all the other light sources are dim? Photo: Biolumenscence (an eerie blue glow produced by ocean creatures) in the East China Sea, witnessed by the side of a ship. Photo by Jordan Crouch courtesy of the U.S. Navy. Bright content simply means emitting light. Most things in our world produce light because they have energy that originally came from the Sun, which is the biggest, brightest thing we can see. Strictly speaking, although the Moon seems to exhale light, it's not really bright because it's just reflecting the light from the Sun like a giant mirror of rock. Bright is quite a vague word really. Undoubtedly, even a lens bulb is bright, because it converts electricity (electricity) into light and shines it towards us. But bulbs like this are incandescent and make light by producing heat. Luminescent things, by contrast, make light when their atoms become excited in a process that needs little or no heat to make it happen. Photo: Bright does not mean shining in the dark: it means that an object emits light that produces itself. Strictly speaking, this means that the Sun (top) is bright, but the Moon (below) is not. Images courtesy of NASA Goddard Space Flight Center (Sun) and NASA Jet Propulsion Laboratory (Moon), via NASA on the Commons. What is the difference between light, fluorescence and phosphorus? Photo: This bright dial clock is coated with fluorescent paint so that it shines in the dark. It is surprisingly difficult to photograph (without cheating!) because it emits very little light. Fluorescent materials produce light immediately, when atoms within them absorb energy and become excited. They shine ultraviolet (UV) light on a stolen TV or camera and you may find someone's address shining back at you, written in invisible ink. The ink consists of fluorescent chemicals that absorb energy from UV light, become excited, and then give out energy as visible light. Turn off the UV light and the ink disappears again. You can read more about how individuals make light in the feature box in our article on light. When we talk about bright clocks and colours, what we really mean is phosphorus, which is very similar to fluorescence: the process by which energy-saving lamps make light. Photo: A energy-saving compact fluorescent lamp The fluorescent chemical is a kind of chalk white coating inside thin glass tubes. You may have noticed that lamps like this continue to shine a little even after you turn them off? Like bright clocks, phosphorus chemicals are still excited enough to exhale light for some time after they have been stimulated. Phosphates work in the same way as fluorescent materials, except that there is a delay between them that absorbs energy and gives out light. Sometimes the phosphorus lasts for a few seconds after the stimulant energy is removed. Sometimes—as in bright watches—it lasts for hours. You've probably noticed that it takes a bit of time to charge up a bright clock with energy before it shines in the dark. You may also have noticed that a bright clock shines more in the early part of the night. By the time dawn broke, he usually run out of energy and stopped shining. This should not come as a real surprise. A watch can't make light out of nothing at all without violating one of the most basic laws of physics-energy conservation. Photo: A blue-green glow stick makes light using chemoluminscence. Photo by Demetrius Kennon courtesy of the U.S. Navy. Light on a bright clock and shine straight back at you. This is an example of what we call photoluminescies: brightness is made by light. But you can make things exhale light by exciting their people with many other kinds of energy. You give individuals a kind of energy (light, heat, sound, or whatever) and give the same energy back to you as light. Scientists have almost a whole A-Z (well a B-T anyway!) of words to describe the different kinds of brightness: Bioluminescence: made from living creatures like fireflies, flash-worms, and many marine creatures. Chemoluminescion: made by a chemical reaction. Glow sticks work this way. Electroluminesc disease: it is done by passing electricity through something like a gas. Photoluminescies: made with bright light in bright (phosphorous) colors. Röntgenolumencence: made from shining X-rays to things. (The strange name comes from Wilhelm Röntgen (1845-1923), the discoverer of X-rays.) Sonolumonescence: made by passing energy sound waves through liquids. Thermoluminesc disease: occurs when photons are emitted from hot materials. Triboluminscence: made by rubbing, scratching, or physically deforming crystals. Fireflies and glow-worms Fireflies and glow-worms (their larvae) are the best-known examples of bioluminescent creatures. They use a complex reaction to make light from a pair of chemicals called luciferin and luciferase in their tails. Bioluminesc disease is a special type of chemoluminesc disease that occurs within living beings. Creatures of deep Squids, shrimps, sardines, plankton, starfish, and all kinds of other marine creatures use bioluminescies to communicate, camouflage, or defense-flashing to attract mates or warn away predators. Photo: Bioluminescies in action. Action. Corals and croonoid bioluminescies in the North Atlantic. Photo courtesy of Bioluminscence 2009 Expedition, NOAA/OER, published on Flickr under Creative Commons license. Right: A bioluminescent phosphate. Photo courtesy of NOAA Okeanos Explorer Program, Gulf of Mexico 2012 Expedition, published on Flickr under Creative Commons license. Photo: The spectacular glow of this oven timer is caused by phosphorus that make the green light when their electrons strike, briefly charging them with energy. It's an example of what's called a vacuum fluorescent screen. Bright (fluorescent) colors, energy-saving fluorescent lamps and fluorescent (high visibility) jackets are obvious examples. But there are many other ways we use brightness too. Old cathode ray televisions (and oscilloscopes) make pictures of shooting electron guns on a screen coated with phosphorus (phosphorous chemicals). Lasers make their strong rays from a process called stimulated emission, which occurs when atoms are forced to e-light photons over and over again. UV lights are used to produce phosphorus in a variety of medical trials, in archaeological research, and in forensic science to help identify crime. Photo: Lane Safety: old style, fluorescent silver color makes this black jacket appear at night in car headlights or, in this case, in the flash of my camera. This is the kind of low-tech, high-visibility it has been for decades and its big disadvantage is that it dazzles quickly and loses its reflectivity. Newer high visibility jackets and vests have retro fabric s sewing directly on them. It is made of materials such as 3M™ Scotchlite™, which uses tiny reflective beads to shed back more light. It is much brighter than the legacy color and lasts much longer. Some uses of brightness are even more surprising. Many washing detergents contain ingredients known as optical brightens, which are actually phosphorous chemicals. Sunlight contains a mixture of ordinary, visible light (which our eyes can see) and ultraviolet light (which we cannot see). When sunlight falls on newly washed garments, atoms of optical-brightening chemicals, left behind by detergents, become excited and convert ultraviolet sunlight into ordinary light. As a result, when you look at newly washed white garments, you're supposed to see brighter, slightly blue reflected light produced by optical brighteners. The idea is that your clothes look cleaner and brighter, which is why the TV they used to talk about blue whiteness and featured smiling people holding their clothes up to a window (where there is more uv-rich sunlight) to see it. It's amazing some of the places where you can find science-even lurking in your washing machine! Photo: Ultraviolet lamps like this can be used to display invisible security inks that deter thieves. Photo by Warren Gretz courtesy of the U.S. Department of Energy/National Renewable Energy Laboratory (DOE/NREL). The best Alarm in the world can't always keep thieves out of your home and if your valuables get stolen they often go for good. Even if the police catch the crooks and recover some of their loot, how can they ever return it to its rightful owners? Who knows which camera or TV belongs to which person? Science offers a really easy solution! All you have to do is mark your property with an invisible, fluorescent ink that only appears in ultraviolet light. When police recover stolen property, they will wave an ultraviolet lamp over it, the signs (perhaps your name or zip code) appear, and immediately find out who it belongs to. Now, if the ink is invisible and only appears in invisible ultraviolet light, how come you can see it when one of these special lights shines on it? As we've already seen, atoms make light when they absorb energy, then emit (give) the same energy a few minutes later. What happens with invisible security ink is that atoms absorb ultraviolet light, but then give a slightly different, blue light that our eyes can see. (This is like the process that occurs on the white outer coating of a fluorescent lamp, which converts ultraviolet light made inside the tube into visible light that brightens up our homes.) Photo: How invisible security inks and colors work, compared to normal inks and colors. 1) In the usual white light (colored yellow here so it appears), regular inks appear because they absorb all light rays except those of their color, which they reflect. So the red ink looks red in white light. 2) In ultraviolet light, ordinary inks tend to turn black. 3) When white light (again colored yellow in this diagram) shines in invisible UV ink, the ink reflects light as light our eyes can't see-so it remains invisible. 4) In ultraviolet light, invisible ink reflects visible light so that red or other color appears. Atoms fluorescent fluorescent light bulbs reveal the incredible productivity of America's corn belt by Betsy Mason. Wired, April 3, 2014. NASA satellites use fluorescence to map photosynthesis from space. PhotoLuminescent Nanoparticles Kill Cancer by Dexter Johnson. IEEE Spectrum, April 17, 2014. Researchers are discovering how tiny copper-cysteamine particles (Cu-Cy) can be tossed with X-rays to produce brightness that will fight cancer cells. Fluorescence is prevalent in fish, study finds by James Gorman. The New York Times. January 8, 2014. There are 180 species of fluorescent fish, according to scientists from the American Museum of Physics The Fantastic Light: Harnessing Nature's Glow by Paul Rincorn. BBC News, 24 January 2013. It describes some of the practical applications of bioluminesc disease, particularly in medicine. Bioluminescies: illuminating the natural world: BBC Nature Features, 16 January 2013. A great overview of bioluminescance, including videos and photos. [Archived through wayback machine.]