Opinion

Materials that glow

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Sandhya Verma
Department of Chemistry and Bio molecular Sciences, Macquarie University, Australia

Correspondence: Sandhya Verma, Department of Chemistry and Bio molecular Sciences, Macquarie University, Sydney, Australia, Tel +917838973539, Email Sandhya.verm@hdr.mq.edu.au

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The adoption of energy saving lighting sources have offered a promising strategy to drastically cut the country's overall energy demand. Therefore, energy- efficient lighting fixtures are tailored effectively to meet the demands for competent lighting materials to suit the needs of the society. This prompts me to talk about the phenomena of luminescence and the substances which generate it. The emission of light by a substance that has not been heated to the degree of incandescence is referred to as luminescence. It is a type of light emission that is caused by a variety of mechanisms, including fluorescence, phosphorescence and chemilluminescence.

Lighting, medical imaging, and materials research are just a few of the many applications of luminescence. It occurs when a substance absorbs energy, allowing its electrons to move from one energy level to another. The extra energy is released as light when these electrons return to their lower energy state. The energy disparity between the higher and lower energy levels determines the color of the emitted light.

The concept of producing something that glows was incredible in and of itself. My interest in luminescence originated during my master research. Afterwards, I continued my PhD studies at the same university, where my supervisor further fueled my interest in luminescence. To me, the most crucial question was why scientists should investigate luminescence, the answer to which is way beyond the scope of this article. But I have made an effort to swiftly discuss the four most well- known mechanisms of luminescence, namely fluorescence, phosphorescence, chemiluminescence and delayed fluorescence.

When a certain wavelength of light excites fluorescent molecules, they release longer wavelength light as a result. Specialized imaging devices and microscopes can be used to detect the emitted light. Fluorescence is type of luminescence that is widely used in biological research, such as for labelling molecules and visualizing biological structures.

Fluorescence and phosphorescence are comparable phenomena; however, phosphorescence emits light over an extended amount of time following the initial excitation. Due to this quality, phosphorescent materials are helpful in a variety of applications, including exit signs and glow-in-the-dark toys. On the other hand, when a chemical reaction results in light, the process is known as chemiluminescence. Several uses, including forensic research and medical diagnostics, call for this kind of luminescence.

Another important application of luminescence is in the field of display technology namely OLEDs (Organic light- emitting diodes). A remarkable leap from research lab to industrial applications has been made by OLEDs made of luminous materials. This technology has weaved promising molecules together to achieve materials with best lighting efficiency and display characteristics. This brings me to a quick discussion of, yet another important class of emission called as thermally activated delayed fluorescence (TADF), which is not exactly an unfamiliar phenomenon.

Briefly speaking TADF is an emission mechanism that employs both fluorescent and phosphorescent excited states of the molecules to achieve nearly 100% of the lighting efficiency. The essential feature of TADF is the long-lasting intermediate state in which the energy needed to generate light is stored. Due to the delayed emission, the excited energy state can dissipate its energy as light rather than heat. Organic light-emitting diodes (OLEDs) can use TADF to improve their efficiency and lower their energy usage.

Overall, luminescence is a remarkable phenomenon that has applications in numerous branches of science and technology. Due to its special characteristics, it has become a crucial tool for scientists and engineers working in a variety of sectors. Materials that glow gives incredible new opportunities and empowers scientists to push the boundaries of what's possible.

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