Color control technology using candy light-emitting principle

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A Korean research team developed a mechanoluminescence color control technology that can change green light to red light by simulating the candy light-emitting principle.

A research team at Daegu Gyeongbuk Institute of Science and Technology (DGIST), South Korea, developed a mechanoluminescence color control technology that can change green light to red light by simulating the candy light-emitting principle.

DGIST announced that research team led by Dr. Soon Moon Jeong developed a mechanoluminescence color control technology that can change green light to red light by simulating the candy light-emitting principle. The technology is expected to be used for displays and lights that require no external electricity.

Mechanoluminescence: a method of light emission that requires no external electric power and which applies a mechanical force to a material to cause motion and the recombination of electrons in the material that in turn transmits mechanical energy to light energy.

The research team noted that blue light is emitted when wintergreen-flavored candy (ex. Lifesavers) is bitten or smashed. In general, it is known that mechanoluminescence in the ultraviolet region is generated when the sugar component in the candy is broken. Natural vegetable oil is a material that generates a blue color by absorbing ultraviolet, thus wintergreen-flavored candy containing natural vegetable oil emits a blue light when it is smashed.

The research team thus combined this phenomenon with mechanoluminescence research and developed a color control technology that allows the existing green light in the mechanoluminescence material to be absorbed and red light to be generated by mixing single green mechanoluminescence material and organic fluorescent dye.

When rubbing a substrate that is coated with organic fluorescent dye with a mixture of mechanoluminescence materials (ex. ZnS and PDMS) and silicone rubber, the mechanoluminescence materials that are heavier than the silicon rubber will sink to the bottom of the substrate, while the silicon rubber is being hardened and the organic fluorescent dye will be evenly spread over its top forming a natural double-layered structure. An experiment confirmed that when mechanical force is applied on the substrate, the light-emitting layer in the mechanoluminescence material generates green light, and the color conversion layer where the organic fluorescent dye is spread on the rubber converts this green light into red light.

Through these experiments, the team proved that it is possible to express a variety of colors depending on the mixture ratio of the single mechanoluminescence materials and organic fluorescent dye. Color conversion efficiency can also be increased through the diffusion of the organic fluorescent dye. Further, this structure can be applied to an electric field that generates light electrically, so the team also developed a hybrid element implementing patterns that enable mechanoluminescence light-emission and electrical light emission simultaneously yet independently.

In contrast to existing studies that relied on the development of mechanoluminescence materials based on the fact that mechanoluminescence material affects the color of light produced, the findings of this study have been evaluated highly in the sense that they pioneered mechanoluminescence color control technology by enabling a larger variety of color expression by combining organic fluorescent dye.

This mechanoluminescence light-emitting phenomenon can be applied to displays, lights, and sensors without external electric power; thus, it is expected to be used in the development of environment-friendly displays that cause no energy or environmental problems.

Dr. Soon Moon Jeong from Division of Nano and Energy Convergence Research said, "The core of this study is that we discovered that a variety of colors can be generated by combining mechanoluminescence materials as well as organic fluorescent dye that are widely and commonly used. I'll continue to conduct research that improves energy and environmental issues by using mechanoluminescence phenomena."

More information: Soon Moon Jeong et al. Mechanoluminescence Color Conversion by Spontaneous Fluorescent-Dye-Diffusion in Elastomeric Zinc Sulfide Composite, *Advanced Functional Materials* (2016). DOI: 10.1002/adfm.201601461

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