

December 13, 2022

Toshiba Corporation

**Toshiba Develops Transparent Photoluminescent Phosphor
for LED, Sensing and Security Printing Applications**

TOKYO—Toshiba Corporation (TOKYO: 6502) has unveiled a technology breakthrough in photoluminescence, a novel phosphor that delivers excellent solubility in polymers or organic solvents, where it is transparent and colorless under visible light, and that emits persistent red-light emissions under UV light, with excellent color purity and a luminescence six times that of current phosphors. These characteristics open up many potential applications in areas that include LED lighting, displays, deep UV sensing, security printing, and pesticide residue testing.

A phosphor is a substance that absorbs energy from a light source, such as UV or visible light, and releases that energy by emitting colored light. Phosphors are commonly used in LED lighting and displays, and in security printing. However, in the field of mini- and micro-LED lighting and displays, where the chips used are very small, the inorganic phosphors typically used have a limited color reproduction capability and luminescence intensity. These phosphors are also insoluble and exist as fine particles, and when used in security printing, printed patterns become faintly visible, depending on the angle of view and light exposure. Toshiba's new phosphor overcomes these problems.



Applications of Toshiba's New Phosphor



Micro-LED, Displays

Micro-LED lighting and displays optimize either color purity or brightness, not both. Toshiba's phosphor can overcome this dilemma.



Deep UV Sensing

The phosphor emits red light in a range from deep UV to violet (222 nm to 405 nm). At 222 nm it sterilizes viruses, with little impact on people. Deep UV also reveals the color instantly, and can be used in UV lighting design and sensing.



Security Printing

Colorless and transparent under visible light, Toshiba's phosphor shines out brightly under UV light. A strong feature for use in security printing.



Pesticide Residue Testing

On contact with Dichlorvos, a widely banned organophosphorous pesticide, emissions are extinguished, realizing quick and easy residue testing without sophisticated analytical equipment.



Figure 1: Applications of Toshiba's New Phosphor

Toshiba has focused its photoluminescence research on novel lanthanide luminescent complexes. The company has developed a proprietary molecular design method, and used this to bind the ions of a standard Eu(III) luminescent complex with two or more phosphine oxide structures, including a branched tetrakisphosphine tetraoxide ligand recently discovered by Toshiba (Figure 2). This created a new structure that is highly soluble, with excellent transparency, and that successfully increases luminescence intensity to achieve high color purity and durable emission. The molecular design method also has the potential to create phosphors that emit different colored light when applied to different luminescent complexes. (Figure 3)

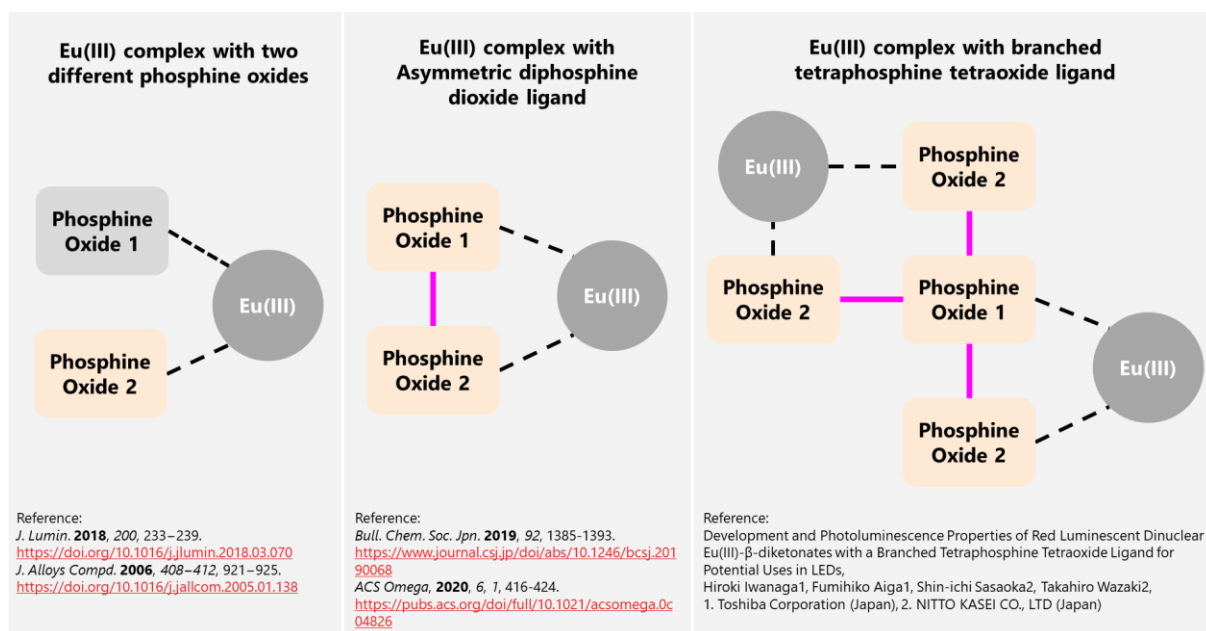


Figure 2: Eu(III) complexes with two or more different phosphine oxide structures realized by Toshiba’s molecular design method.



Figure 3: The molecular design method has the potential to create phosphors that emit different colored light when applied to different luminescent complexes.

Researchers from Toshiba will present the technology and showcase red LEDs and fluorescent films as applications at [the 29th International Display Workshops \(IDW '22\)](#)

from December 14 to 16. A [paper](#) covering the technology will also be published on the IDW' 22 website.

Toshiba will soon begin to provide samples of the phosphor and fluorescent films and explore partnerships for applications in many areas, including the lighting, display, printing and chemical industries. The company aims to start mass production in 2025.

Specifications of the new phosphor

Appearance	Milky white powder
Excitation spectrum	Deep ultraviolet (222 nm) to purple (405 nm)
Emission spectrum	613 nm (red)
Resin solubility	1×10^{-3} mol/l in ethyl acetate and hexane

About Toshiba Corporation

Toshiba Corporation leads a global group of companies that combines knowledge and capabilities from over 140 years of experience in a wide range of businesses—from energy and social infrastructure to electronic devices—with world-class capabilities in information processing, digital and AI technologies. These distinctive strengths support Toshiba's continued evolution toward becoming an Infrastructure Services Company that promotes data utilization and digitization, and one of the world's leading cyber-physical-systems technology companies. Guided by the Basic Commitment of the Toshiba Group, "Committed to People, Committed to the Future," Toshiba contributes to society's positive development with services and solutions that lead to a better world. The Group and its 120,000 employees worldwide secured annual sales of 3.3 trillion yen (US\$27.4 billion) in fiscal year 2021.

Find out more about Toshiba at www.global.toshiba/ww/outline/corporate.html