Chemical Engineering for "Pb-Free" Double Perovskite Short-Wave IR (SWIR) Materials

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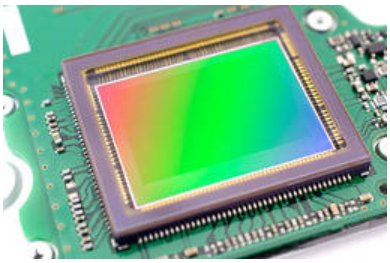

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Abstract

Traditional SWIR materials are composed of toxic materials such as InGaAs, HgCdTe, InSb, and recent Pb-based pervoskites. These materials are toxic and unstable. This technology is for an environmentally-friendlier "Pb-free" double perovskite short-wave IR (SWIR) material. The precursors for the SWIR materials are universal, cheap, and nontoxic, unlike existing alloy SWIR materials. The materials have a broad absorbance from 500 nm to 2800 nm and can easily be extended to other double-metallic materials.

Problem

SWIR imaging sensors detect short-wave infrared light to produce high-res images, distinguish colors, and enable night vision. Current SWIR tech uses Indium Gallium Arsenide detectors, which are costly, hazardous, and hard to scale for production

Solution

Precursors used to produce these SWIR materials are widely available, low-cost, and non-toxic. Combined with a simplified synthesis method, this technology enhances SWIR material manufacturing while preserving absorbance and sensitivity leve

Value Proposition

This technology targets SWIR manufacturers seeking lower costs, easier synthesis, and better scalability—offering eco-friendly SWIR materials with the same performance as traditional options.

Benefit

USU researchers have created a promising alternative to conventional SWIR (short-wave infrared) detector materials. Traditionally, SWIR detectors rely on materials such as Indium Gallium Arsenide (InGaAs), Lead Sulfide (PbS), and Lead Selenide (PbSe). While effective, these materials come with significant drawbacks: they are hazardous to both human health and the environment, involve complex and costly synthesis processes, and are difficult to scale for widespread production. In contrast, this new technology utilizes non-toxic, low-cost, and more readily available materials. It also features a simplified synthesis method, making it easier to manufacture at scale. Despite the shift in materials, it retains the high absorbance and sensitivity needed for effective SWIR detection, making it a compelling, environmentally conscious, and economically viable replacement for traditional SWIR detectors.

Short-wave infrared (SWIR) materials are essential for detecting and imaging wavelengths in the 0.9 to 2.5 micrometer range, enabling visibility beyond the capabilities of traditional visible-light sensors. In industry, SWIR materials are widely used in applications such as semiconductor inspection, quality control in manufacturing, surveillance, agricultural monitoring, and biomedical imaging. These materials allow for the detection of moisture, heat signatures, and hidden defects, making them valuable for non-destructive testing and process optimization. In sectors like defense and security, SWIR is critical for night vision and target identification in low-light conditions. The unique ability of SWIR sensors to penetrate haze, smoke, and certain packaging materials also makes them indispensable in automated sorting and industrial inspection systems.

Market Application

Businesses in semiconductor inspection, manufacturing quality control, surveillance, agricultural monitoring, and biomedical imaging use SWIR materials.

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Intellectual Property

Pending U.S. Non-Provisional Patent Application Filed February 2024.