Docket #: S24-425

High-Quality PbGeSe Thin Films for Stable Infrared Light Emission in Gas Sensing

Stanford researchers have developed a new method for producing high-quality lead-germanium-selenide (PbGeSe) thin films with improved optical performance and uniformity. These films are designed for use in compact infrared light emitters, particularly for gas sensing applications such as methane detection.

Traditional approaches to tuning the emission wavelength of lead selenide (PbSe) for infrared devices face several challenges, such as substituting elements like strontium or europium can degrade optical quality, and using cadmium raises toxicity concerns. By incorporating germanium (Ge), the team has achieved films that emit light at shorter wavelengths (3–4 microns), ideal for detecting gases like methane. The process starts by depositing the material onto a specially prepared surface at low temperatures. A protective layer is then added, which shields the film during a final heating step that ensures Ge is fully incorporated into PbSe.

This approach ensures uniform Ge incorporation and prevents film degradation, resulting in stable emission wavelengths that are largely unaffected by temperature changes, which is a key advantage for reliable gas sensing in varying environments.

Stage of Development: Prototype

Applications

- Environmental emissions monitoring and methane leak detection
- Infrared optoelectronic devices (emitters and detectors)
- Quantum devices and thermoelectrics

Advantages

- Stable emission wavelength with minimal temperature dependence, reducing the need for calibration in sensors.
- Improved optical quality and uniformity
- Avoids toxic elements like cadmium
- Simpler and lower-cost manufacturing compared to III-V semiconductor lasers and LEDs

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