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Cubic MgSrO Lattice Matched with Cubic GaN, Cubic ScN, and Cubic 3C-SiC Crystal Substrates

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Inventors

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Background

A primary difficulty in the manufacture of light emitting diodes (LEDs) and laser diodes (LDs) is the manufacture of crystal substrates. Standard technologies are created using layers of binary gallium nitride (GaN) and crystal lattices. Unfortunately, crystal lattices have different atomic spacing, or morphology, than the GaN layers, causing structural defects. These defects make LEDs and LDs to be less efficient and less effective. Recent advancements have attempted making small single crystal GaN structures, but there are still so many defects that performance is suboptimal. These smaller crystals are also more expensive and difficult to manufacture. Ideally, manufacturers could use lattice-matched single crystal substrates to manufacture higher quality GaN-based LEDs and LDs.

Invention Description

Researchers at ASU have invented a method of using wide bandgap, optically transparent, lattice-matched, single crystal cubic MgSrO substrates that may be tuned to have a cubic structure with a lattice constant matched exactly to cubic GaN. Exact composition of the crystal can be adjusted for creation of crystals with specified atomic spacing. Wide bandgap allows crystals to operate at higher voltages, frequencies, and temperatures than conventional crystals. Familiar manufacturing techniques are used to grow these MgSrO substrates. This technique allows for the manufacture of perfectly lattice-matched single crystals with improved thermal and chemical stability, drastically improving performance of LED and LD devices. These lattices can also be matched with ScN and 3C-SiC substrates.

Potential Applications

- LED and LD manufacture
- Power electronics
- Semiconductors
- Personal Electronics
- Lasers
- Health care

Intellectual Property Status:

Pending

Benefits and Advantages

- **Lower Costs** – Familiar manufacturing methods are used to create crystals, so production can easily be implemented into existing processes.
- **Efficiency** – LEDs and LDs with these substrates have fewer morphological defects, making the diodes more efficient.
- **Efficacy** – Fewer morphological defects make LEDs and LDs more effective.
- **Versatility**– Exact composition of crystal substrates can be altered for each specific use.
- **Stability** – Improved chemical and thermal stability over standard crystals.

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