Photovoltaic solar concentrator design uses Spherical Gradient Index (GRIN) lens to achieve efficient and simple solar power conversion

Technology #m11-020

The efficient conversion of solar energy to electricity is limited by the wavelength-dependent properties of the mirrors and lenses used in conventional photovoltaic concentrator devices to focus sunlight. Spherical Gradient Index (GRIN) lens allows light composed of various wavelengths to be focused at the same distance, thus promoting more efficient sunlight focusing and solar power conversion. The varying refractive index of the GRIN lens material enables perfect imaging and high flux concentration of sunlight. This technology presents a photovoltaic concentrator design consisting of a single GRIN lens moving in a spherical trajectory to track the sun’s position throughout the day. This allows the module to be enclosed in a box with no external moving parts to reduce the complexity of the solar concentrator.

Quasi-stationary GRIN lens solar concentrator design boosts efficiency by focusing a wide range of wavelengths using no external moving parts

This technology is a solution for optimizing the solar energy conversion process and minimizing system complexity. Efficient power conversion is achieved with a Spherical Gradient Index (GRIN) lens that can focus a wide range of wavelengths (light) at the same distance. Complexity is minimized through re-engineering of the traditional photovoltaic concentrator. By enclosing only one moving lens in a box, the photovoltaic cell can remain stationary, eliminating the external moving parts present in conventional photovoltaic concentrators.

The dispersion loss for GRIN lenses was evaluated using a solar spectrum and found to be far lower than that for conventional homogenous lenses.

Lead Inventor:

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Applications:

- Photovoltaic solar concentrators, enabling very high concentration with only one optical element;
- Applications include rooftop solar panels and use in solar farms;
- Focusing light on an optical fiber and delivering natural light for indoor applications;
- GRIN lens for photography and infrared imaging;
- Radiation concentration.

Advantages:

- Spherical Gradient Index (GRIN) lens achieves efficient focusing of sunlight without moving;
- Unique refractive properties allow perfect focusing over the very wide field of view of the lens (360 degrees);
- The mechanical systems are optimized and simplified; the self-contained photovoltaic solar concentrator does not contain any external moving parts;
- Various refractive index profiles allows GRIN lens to be manufactured by currently available materials and fabrication techniques.

Patent information:

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Available for licensing and sponsored research support

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Related Publications:


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