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HOLOGRAPHIC CONCENTRATOR FOR DIFFERENT TYPE OF SOLAR CELLS OF DIFFERENT BAND GAPS

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Abstract:
The investigation for optimum efficiency in photovoltaic power generation has led to the creation of nano-wire solar cells, which are made up of thin wires formed of absorber materials with varying band gaps. For such nanowire solar cells, spectrum splitting and a focused line spectrum are very desirable. This may be accomplished by using a grating and a concentrating lens, or a prism and a concentrating lens. Traditional systems that use these components, on the other hand, are big and costly. The usage of a compound holographic element, which combines a lens and a grating, on the other hand, has various advantages, including lightweight construction, cheap cost, and simplicity of production.
Keywords: *Holographic Concentrator, Solar Cells, Diffractive optical elements, Photovoltaic (PV) technologies*

1. Introduction

The use of concentrators in Photovoltaic (PV) technologies solar cells has the potential to lower the cost of solar cells by substituting a cost-effective solar cell area with a smaller concentrator area. It should be emphasized, however, that focusing the full solar spectrum onto a photovoltaic cell is not optimum for energy generation. Such concentrators, which focus the whole solar spectrum into a single region, are better suited for photothermal processes, which attempt to convert solar energy into heat with a generally consistent efficiency over the entire solar spectrum. Photovoltaic conversion, on the other hand, depends significantly on the wavelength of the input light and operates most efficiently when the photons have energies near the band gap energy of the PV cell. Photons with energy less than the band gap pass through the active region of the cell without being absorbed, dissipating their energy as heat in other regions of the cell. Photons with energies larger than the band gap can only be partially utilised, with the surplus energy escaping as heat. The portion of the solar spectrum that does not fit the band gap of the absorber material produces heat and reduces the overall display efficiency. Consequently, cooling techniques are required to maintain an adequate efficiency level. A more successful approach is to use a spectral beam splitting algorithm to focus only the appropriate segment of the sun spectrum onto the PV receiver, as shown in Figure 1.