

Solar Building Design Using GaAs PV Cells for Optimum Energy Consumption

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Abstract : Gallium arsenide (GaAs) solar cells are widely used in applications like spacecraft and satellites because they have a high absorption coefficient and efficiency and can withstand high-energy particles such as electrons and protons. With the energy crisis, there's a growing need for efficiency and cost-effective solar cells. GaAs cells, with their 46% efficiency compared to silicon cells 23% can be utilized in buildings to achieve nearly zero emissions. This way, we can use irradiation and convert more solar energy into electricity. III V semiconductors used in these cells offer performance compared to other technologies available. However, despite these advantages, Si cells dominate the market due to their prices. In our study, we took an approach by using software from the start to gather all information. By doing so, we aimed to design the optimal building that harnesses the full potential of solar energy. Our modeling results reveal a future; for GaAs cells, we utilized the Grasshopper plugin for modeling and optimization purposes. To assess radiation, weather data, solar energy levels and other factors, we relied on the Ladybug and Honeybee plugins. We have shown that silicon solar cells may not always be the choice for meeting electricity demands, particularly when higher power output is required. Therefore, when it comes to power consumption and the available surface area for photovoltaic (PV) installation, it may be necessary to consider efficient solar cell options, like GaAs solar cells. By considering the building requirements and utilizing GaAs technology, we were able to optimize the PV surface area.

Keywords : gallium arsenide (GaAs), optimization, sustainable building, GaAs solar cells

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