SNS COLLEGE OF ENGINEERING

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Department of Electronics and Communication Engineering

19OE625 - SUSTAINABLE ENERGY SYSTEMS AND TECHNOLOGIES

Introduction to Solar Cells and Solar Modules

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Solar cells convert sunlight directly into electricity. Solar modules are panels made of multiple cells, producing higher wattage for practical use.

Photovoltaic Effect and Semiconductor Materials

1 Photovoltaic Effect

Light energy knocks electrons loose in a semiconductor material, creating an electrical current.

2 Semiconductor Materials

Silicon is the most common material used in solar cells, but other materials like gallium arsenide and cadmium telluride are being explored.

3 Doping Process

Adding impurities to the semiconductor creates a p-type or n-type region, facilitating current flow.

4 Junction Formation

A p-n junction is formed by combining p-type and n-type semiconductors, creating an electric field that drives current flow.

Structure and Components of Solar Cells

Front Contact

The front surface of the cell, typically with a thin layer of metal for electrical connections.

Anti-reflective Coating

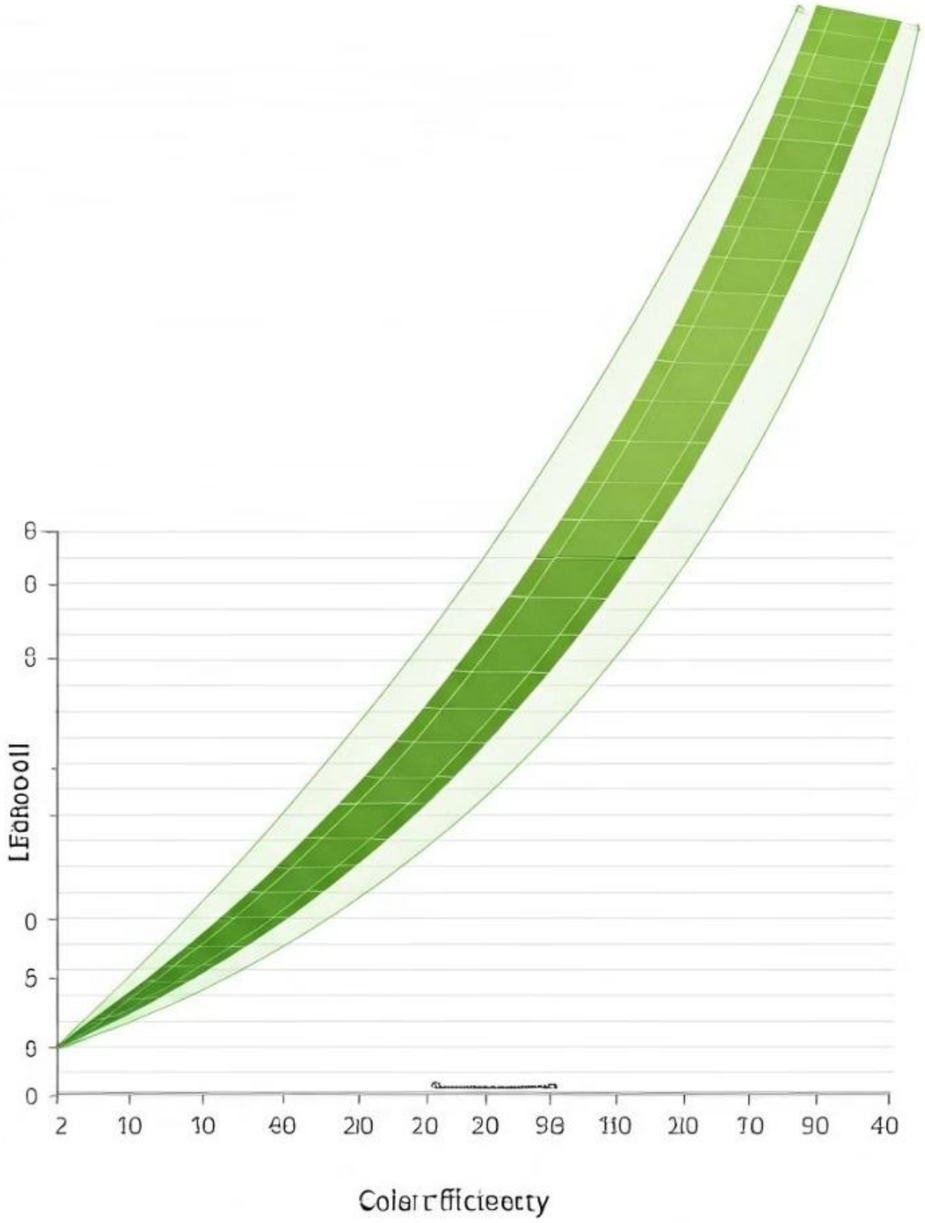
Reduces reflection of light, maximizing the amount of light absorbed by the semiconductor.

p-type and n-type Layers

These layers are the core of the cell, where the photovoltaic effect takes place.

Efficiency and Performance Factors

Factor	Description
Conversion Efficiency	Percentage of light energy converted into electricity.
Temperature Coefficient	Efficiency reduction per degree Celsius increase in temperature.
Spectral Response	Sensitivity of the cell to different wavelengths of light.



Solar Module Design and Configurations

Monocrystalline Modules

Made from a single crystal of silicon, offering higher efficiency but generally more expensive.

Polycrystalline Modules

Made from multiple silicon crystals, lower cost but slightly lower efficiency compared to monocrystalline.

Thin Film Modules

Use thin layers of semiconductor materials, typically less expensive and can be flexible.

Installation and Mounting Considerations

1

Site Selection

Maximize sunlight exposure, consider shading, and roof structure.

2

Mounting Structure

Choose a sturdy mounting system compatible with the roof and modules.

3

Wiring and Connections

Connect modules in series or parallel, ensuring proper grounding and safety.

4

Grid Tie-in

Connect the system to the electrical grid through a certified inverter.

Maintenance and Durability of Solar Systems

1 Regular Cleaning

Remove dirt and debris from the panels to ensure maximum light absorption.

2 Visual Inspection

Check for damage, loose connections, or signs of wear and tear.

3 Monitoring System

Use a monitoring system to track performance and detect potential issues.

4 Component Replacement

Replace damaged or worn-out components as needed to ensure optimal performance.

Applications and Future Trends

Grid-tied Systems

Supply electricity to the power grid, reducing reliance on fossil fuels.

Residential Applications

Power homes, reducing energy bills and carbon footprint.

Electric Vehicles

Charge electric vehicles, promoting cleaner transportation.

Space Exploration

Power satellites, space stations, and other space-based missions.


THANK YOU