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# Low-Cost Nanostructured Substrates for Efficient Epitaxial Lift-Off of III-V Solar Cells

In order to reduce the high costs associated with renewable power, there is a need to develop highly efficient photovoltaic materials, and III-V compound semiconductors offer a higher efficiency than conventional materials. However, high production costs limit widespread photovoltaic development.

The substrates used to manufacture compound semiconductor are expensive and the removal process requires a complex etching of a sacrificial layer, making reuse costly. Therefore, there is a need to develop a reusable substrate for a more economically feasible form of production for compound solar cells.

Researchers at Arizona State University have developed a method of applying reusable cylindrical nanostructures (or "nanopillars"), at a low cost, tailored for epitaxial growth of compound solar cells. Nanopillar substrate technology is recyclable, in addition, allows the opportunity to optimize growth through characteristic control, and applies an easy lift-off, which eliminates the complex removal phase.

Researchers apply chemical vapor deposition to form nanopillars on an inexpensive substrate (e.g. crystalline Si, glass, or metallic film), then the epitaxial compound semiconductor thin film grows on top of the nanostructures. This matrix structure lets the thin film to be cleaved using a simple, epoxy-based, and etching-free lift-off, allowing the substrate to be reused for continuous growth. Through nanopillar application, semiconductor production costs decrease significantly for high efficient solar cells.

Potential Applications

- Solar cells
- Semiconductor manufacturing
- Reusable substrate for compound semiconductor growth

Benefits and Advantages

- Multiple reuse - Epitaxial semiconductor growth on nanostructures for an etching-free lift-off.
- Optimization – Process allows characteristics to be modified and controlled for desired III-V thin film features.
- High-efficiency - Greater than 30% module conversion.
- Low cost production – Estimated cost is at $0.20/Wp and the levelized energy cost approach $0.02-$0.03/kWh by 2030.

For more information about the inventor(s) and their research, please see

Dr. Cun-Zheng Ning's Directory Page