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InGaN Columnar Nano-Heterostructures for Solar Cells

Global energy demand is increasing rapidly in response to growth in both the existing and the emerging economies of the world; consequently, there is unprecedented demand for new solar cell technologies that can provide clean, renewable energy. Thus far, conversion inefficiencies and high production costs have limited the potential of existing photovoltaic devices.

As a result, the primary focus of current photovoltaic cell research is to find new methods and materials to improve device efficiency and cost. To this end, improving the tunnel junctions incorporated in all high-efficiency multi-junction cells today is an aspect of photovoltaic cell technology receiving generous attention from researchers. Tunnel junctions improve the efficiency of photovoltaic cells. Optimally, tunnel junctions should have low impedance to current flow and small potential drop across the junction and should transmit all of the light to the next cell in line; therefore, reducing the tunnel junction thickness for less absorption and increasing the bandgap beyond that of the surrounding cell will improve light transmission, and subsequently, improve efficiency. Still, existing methods for fabricating tunnel junctions with high efficiency require the use of expensive techniques such as metal-organic chemical vapor deposition (MOCVD) and molecular beam epitaxy (MBE).

Researchers at Arizona State University have developed a novel method for growing high quality GaN nano- and micro-columns using chemical vapor deposition (CVD) on gold droplets deposited on fuse silica substrates. The films are highly luminescent and achieve efficiency comparable to that previously seen in thin films grown by more expensive techniques like MOCVD and MBE. These advances may lead to higher efficiency, longer lasting photovoltaic cells at reduced cost.

Potential Applications

- Optoelectronics
- Electroluminescent Devices (e.g. light emitter diodes, laser diodes)
- Photovoltaic Devices

Benefits and Advantages

- Provides High Quality GaN, InN, and InGaN Nano- and Micro-Columns
- High Efficiency
- High Luminescence
- Reduces Manufacturing Costs ? uses chemical vapor deposition as opposed to more expensive metal-organic chemical vapor deposition and molecular beam epitaxial manufacturing techniques

- Offers Favorable Perpendicular Column Growth