

High-Efficiency Dye-Sensitized Solar Cells Based on TiO2 Nanotubes

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BACKGROUND

Photovoltaics have thus far been largely based on semiconductors, e.g., Si, CdTe, and cadmium indium selenide. Solar cells using these materials have increasingly been available commercially but still need improvement relative to stability, cost, and environmental concerns.

A leading alternative solar-cell technology relies on photoelectrochemistry and the absorption and excited-state properties of dye molecules bound to a TiO₂ substrate. Research on such dye-sensitized solar cells (DSSCs) has targeted and achieved higher efficiency. The prevailing approach in fabricating DSSCs has been based on mesoporous random networks of TiO₂ nanocrystals. This approach however suffers from increases in resistance and recombination losses.

TECHNOLOGY DESCRIPTION

UC San Diego researchers have developed new dye sensitized solar-cells, which are based on aligned TiO₂ nanotubes that exhibit improved electron collection efficiency relative to earlier DSSCs. The invention's architecture provides a direct and low-resistance conduit for electron capture while maintaining a very high surface area for covalently binding inorganic or organic sensitizers. With the invention, light can be effectively absorbed even in the near-IR region because the path-length of the TiO₂ nanotube layer is significantly greater than the thickness of the mesoporous TiO₂ layer of traditional DSSCs. The invention provides embodiments that do not require transparent conductive glass at either electrode, which leads to increased efficiency, simplified and compact design, and enhanced manufacturability.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,368,289	06/14/2016	2009-164

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OTHER INFORMATION

KEYWORDS

photovoltaic, solar cell, dye sensitized
solar cell, TiO₂, nanotube

CATEGORIZED AS

- **Materials & Chemicals**
 - Nanomaterials
- **Nanotechnology**
 - Materials
- **Semiconductors**
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 - Processing and Production

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