Nonconfidential Summary Disclosure

UM 9200: Sequential Series Multijunction Dye-Sensitized Solar Cells

THE TECHNOLOGY

UM's Sequential Series Multijunction Dye-Sensitized Solar Cells (UM SSM-DSC) technology features a low cost, easy to manufacture, adaptable, high efficiency solar cell design. By design, the UM SSM-DSC technology harnesses the usable solar spectrum, allowing for higher power per area performance even in low light conditions. The UM SSM-DSC technology is aesthetically adaptable as it is available in a variety of colors and can be affixed to most building materials.

The UM SSM-DSC technology has highest known voltage per area system with solar-to-electric efficiencies of over 10%.

UM's SSM-DSC technology dramatically improves existing DSC technologies including:

Higher Voltage per stack including > 4.0 V with 2.5 mA/cm2 photocurrent density with 6.7% power conversion efficiency with a single stack of five cells. The technology is capable of charging Li-ion batteries from a small surface area of illumination.

Higher Voltage than other series tandem solar cells measuring over 8.0 V (compared to 1.9 V) with two or more stacks.

Higher Voltages than Perovskite Solar Cells (PSCs) measuring over 8.0 V (compared to 2.0 V for PSCs) for the same illuminated area. Better Power Conversion Efficiency (PCE) than Organic Photovoltaics (OPVs) with PCEs at 10.1% at 2.3V from the UM SSM-SDC 3-stack technology. This allows for water electrolysis and CO2 electrolysis with a single, concise illuminated area for use in incident sunlight area applications.

Market opportunities for the UM SSM-DSC technology include uses in power fuel production, charging batteries, and in limited surface area applications such as use in clothing, automobiles, portable charging stations, and portable water electrolyzers.

COMPETITIVE ADVANTAGE

With the demand for global energy is expected to increase by 50% by 2040 (from 18 to 26 TW), the demand for environmentally friendly and cost effective solar technologies will continue to grow.

The UM SSM-DSC technology, by harnessing the usable solar spectrum, exceeds the power per area performance ratio of similar solar cell technologies and offers the highest voltage per area of any known solar cell technology. As a result, this technology is suited to both solar-to-chemical fuel and limited surface area applications.

UM has demonstrated completely solar powered water to hydrogen electrolysis at 7% efficiency using a processable, stable, and affordable technology.

DEVELOPMENT POTENTIAL

Continued Product Development

PATENT STATUS

Patent Pending – Copy available under a NDA

PRINCIPAL INVESTIGATOR(S)

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KEYWORDS

Tandem Dye-Sensitized Solar Cells, Photovoltage, Solar Fuels, Solar Battery Charging, Renewable Energy

PUBLICATIONS

Cheema, H.; Rodrigues, R. R.; Delcamp, J. H. "Sequential Series Multijunction Dye-Sensitized Solar Cells (SSM-DSCs): 4.7 Volts from a Single Illuminated Area" Energy Environ. Sci. 2017, 10, 1764.

Rodrigues, R. R.; Cheema, H.; Delcamp, J. H. "A High Voltage Molecular Engineered Organic Sensitizer-Iron Redox Shuttle Pair: 1.4 V DSC and 3.2 V SSM-DSC Devices" Angew. Chem. Int. Ed. 2018, 57, 5472.

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