Novel Polymers for Polymer Solar Cells, Transistors, and Sensors

Tech ID: 27208 / UC Case 2011-558-0

SUMMARY

UCLA researchers in the Department of Materials Science and Engineering have developed a novel class of conjugated polymers for photo-electronic device applications.

BACKGROUND

Conjugated polymers are of interest for active layer materials in polymer-based light emission devices, solar cells, field effect transistors, photodetectors, batteries, supercapacitors, and sensors. They have the potential to lead to low-cost, flexible, lightweight, and easy processable materials for energy generation applications. However, current polymer materials either suffer from a lack of broad solar absorption or relatively low carrier mobility. Previous conjugated polymer-based solar cells have low efficiencies (~7%), leaving a need for new polymer materials that have both high mobility and low bandgaps in order to harvest a broad spectrum of sunlight.

INNOVATION

A research team led by Professor Yang Yang has invented a novel class of conjugated polymers with low bandgaps (1.4 eV-1.5 eV). These polymer materials have a tunable structure and electronic properties, thereby allowing the use of this material to fit into a variety of applications. Implementing these unique polymers into tandem solar cell devices has resulted in power conversion efficiencies as high as 9.5%, which show excellent stability and reproducibility. These devices have better charge transport properties than other similar materials, giving rise to higher open circuit voltage and short circuit current. With optimization, there is a possibility of achieving 15% efficiency.

APPLICATIONS

- Organic photovoltaic devices
- Tandem solar cells
- Light emitting diodes
- Field effect transistors
- Photodetectors
- Batteries and supercapacitors
- Sensors

ADVANTAGES

- Low bandgap polymers (1.4 eV to 1.5 eV)
- Easy structural modification of polymers
- Control of optical, electrochemical, and electronic properties
- Improved power conversion efficiency
- Excellent solar cell stability and reproducibility

STATE OF DEVELOPMENT

Prototype devices with power conversion efficiency as high as 9.5% have been fabricated and extensively tested, with the prospects of reaching 15% efficiency.

RELATED MATERIALS

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INVENTORS

- Yang, Yang

OTHER INFORMATION

KEYWORDS

Conjugated polymers, low bandgap, photo-electronic devices, organic photovoltaic devices, solar cells, energy generation, light emitting diodes, field effect transistors, photodetectors, batteries, supercapacitors, sensors

CATEGORIZED AS

- **Energy**
  - Solar
- **Engineering**
  - Engineering
  - Other
- **Materials & Chemicals**
  - Electronics Packaging
  - Other
  - Polymers
  - Thin Films

RELATED CASES

2011-558-0

▶ L. Dou, J. Gao, E. Richard, J. You, C. C. Chen, K. C. Cha, Y. He, G. Li, and Ya. Yang. Systematic Investigation of Benzodithiophene- and Diketopyrrolopyrrole-Based Low-Bandgap Polymers Designed for Single Junction and Tandem Polymer Solar Cells. Journal of American Chemical Society. 2012.

OTHER INFORMATION

Transparent PV Portfolio

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,026,899	07/17/2018	2011-558

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Titanium Oxide as the Window Layer for Metal Chalcogenide Photovoltaic Devices
- ▶ Two-Step Processing With Vapor Treatment Of Thin Films Of Organic-Inorganic Perovskite Materials
- ▶ Efficient and Stable Perovskite Solar Cells with All Solution Processed Metal Oxide Transporting Layers
- ▶ High Performance and Flexible Chemical And Bio Sensors Using Metal Oxide Semiconductors
- ▶ Design of Semi-Transparent, Transparent, Stacked or Top-Illuminated Organic Photovoltaic Devices

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