Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M12-226P^
Published: 2/26/2020

Inventors

John (Devens) Gust, Jr.

Paul Liddell

Contact

Shen Yan
shen.yan@skysonginnovations.com

Electrically Conducting Porphyrin and Porphyrin-Fullerene Electropolymers

Conducting polymers are used in applications such as photovoltaic cells, sensors and similar devices. The standard organic solar cells contain such polymers, mixed with an organic or inorganic electron conducting phase, along with metal oxides and a low work function metal. The commonly used polymers are polyacetylenes, polyphenyleneethynylenes (PPE), polyphenylenevinylenes (PPV), polythiophenes, and polyanilines. The polymers have different properties based on their organic structures and substituent groups. The substituents influence the physical and chemical properties and alter the performance of the polymers. However, these polymers have very low efficiencies, which arise due to the deficiencies in their chemical properties.

Researchers at Arizona State University have developed an entirely new class of electrically conducting polymers based on the electropolymerization of monomers consisting of porphyrin or porphyrin-fullerene units. The invention also discloses a method of synthesis of bulk chemical synthesis of a soluble form of the polymers. The method produces polymers, which are solution processable, suitable for spin coating, and otherwise able to be handled and used as bulk materials. The porphyrin macrocycles form an integral part of the polymer backbone, and they are involved in the conductivity mechanism by forming delocalized structures.Researchers at Arizona State University have developed an entirely new class of electrically conducting polymers based on the electropolymerization of monomers consisting of porphyrin or porphyrin-fullerene units. The invention also discloses a method of synthesis of bulk chemical synthesis of a soluble form of the polymers. The method produces polymers, which are solution processable, suitable for spin coating, and otherwise able to be handled and used as bulk materials. The porphyrin macrocycles form an integral part of the polymer backbone, and they are involved in the conductivity mechanism by forming delocalized structures. These compounds can be synthesized easily and have the capability to absorb light in the UV and visible region. The absorption range of the polymer can be tuned to maximize the efficiency in the solar spectrum. These polymers have superior chemical properties, which allow effective conduction of holes and electrons and slow their recombination. The efficiency offered by these porphyrin based polymers makes them an efficacious replacement to the existing materials used in a variety of applications.

Potential Applications

- Photovoltaic cells, sensors and solar cells
- Organic light emitting diodes (OLEDs)
- Batteries and other portable power generation devices
- Porphyrins can be used as water splitting and fuel generation catalysts in fuel

cells

- Sensors, potentiometric detectors and related electronic applications
- Useful as electrochromic materials due to their coloration changes when voltages are applied

Benefits and Advantages

- Provides effective hole conduction leading to high efficiencies
- Slows recombination of holes and electrons following charge separation
- Eliminates the formation of cut-off "islands" of conducting phases and concentration of charges
- Offers the capability for tuning the absorption spectrum for efficient use of the solar spectrum
- Polymer is free of defects, soluble in solution, and can be made in bulk

For more information about the inventor(s) and their research, please see Dr. Devens Gust's directory webpage