Clean Technology

Photovoltaic Capacitor for Direct Solar Energy Conversion and Storage

View U.S. Patent No. 9,065,156 in PDF format.

WARF: P100342US01

Inventors: Hongrui Jiang, Chensha Li, Chi-Wei Lo

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a photovoltaic capacitor capable of directly converting solar energy to electrical energy and storing the electrical energy within the device.

Overview

Significant research is conducted to improve the efficiency and reduce the cost of energy generated by renewable resources. Existing photovoltaic cells and conventional photoelectrochemical cells convert solar energy to electrical energy, but are not capable of directly storing the converted energy. Storage of converted energy must be facilitated through connection to an external device, such as a rechargeable battery. This increases complexity and decreases overall efficiency of the system. Furthermore, batteries require additional space and have life cycle limitations. Photovoltaic devices that directly store solar energy would be highly desirable.

The Invention

UW–Madison researchers have developed a two-electrode bio-inspired photovoltaic capacitor that can directly convert and store solar energy in a single structure. The device includes a transparent electrode and a second electrode disposed opposite from the transparent electrode. The structure features an electrolyte slurry containing semiconducting particles along with particles of low ionic diffusivity. This medium exhibits a combination of photovoltaic and ferroelectric properties. The slurry is sandwiched between the transparent electrode and a membrane of low ionic diffusivity adjacent to the negative electrode.

To harvest energy, incident photons excite the electrons within the semiconducting layer and holes in the electrode to generate electron-hole pairs via the photovoltaic effect of solar energy being absorbed. The electrons attract ions to the cathode electrode, creating a concentration gradient across the device. The device is charged using this process until a saturated electric potential difference is reached. The diffusion force of the ions and electric field are counter-balanced and maintain a stable electrical double layer across the two electrodes.

Applications

- Low-power applications such as RFID tags
- Portable electronics
- Miniaturized electronic systems

Key Benefits

- Enables direct conversion and extended storage of solar energy in a single structure
- Improves efficiency and reduces costs of photovoltaic systems

Additional Information

For More Information About the Inventors

- Hongrui Jiang

Related Intellectual Property

- View Divisional Patent in PDF format.

Tech Fields

- Clean Technology : Energy storage, delivery & resource efficiencies
- Clean Technology : Solar, wind & water technologies

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867