Clean Technology


# Solar Cells Turn HMF to Valuable Platform Molecules

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**WARF: P150132US01**

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a greener, cheaper and more efficient method to convert biomass-derived HMF to furan compounds.**

## Overview

Photoelectrochemical cells (PECs) use solar energy to produce fuels, much as nature does through photosynthesis. In a typical PEC, fuels are formed by reduction reactions at the cathode. For example, water can be reduced to hydrogen gas ($H_2$) or $CO_2$ can be reduced to methanol and methane. To complete the circuit, a reaction has to take place at the anode, typically water oxidation.

However, water oxidation is slow and its product, $O_2$, is not very valuable. Identifying a more useful anode reaction would improve the overall efficiency and utility of PECs. Several efforts have focused on a chemical called HMF (5-hydroxymethylfurfural) commonly derived from biomass sugar. HMF is of great interest because it can be converted to several industrially important molecules.

## The Invention

UW–Madison researchers have developed a new method using solar cells to electrochemically oxidize HMF to highly prized furan compounds, specifically FDCA (2,5-furandicarboxylic acid) and DFF (2,5-diformylfuran). These important compounds are used to produce polymer materials, pharmaceuticals, antifungal agents, organic conductors and much more.

The reaction takes place at ambient temperature and pressure using a TEMPO mediator. Unlike previous methods, the process does not require a precious metal catalyst.

## Applications

- Production of FDCA and DFF – important building block molecules used to make a variety of materials and chemicals

## Key Benefits

- Practical and environmentally friendly
- High yield
- No expensive catalyst electrodes
- Works at ambient temperature and pressure
- Lower pH solutions, stable conditions
- Boosts the efficiency and utility of PECs

## Stage of Development

The researchers have produced FDCA in high yield (99 percent) and reduced the time required for complete conversion to one hour.

## Additional Information

**For More Information About the Inventors**

- Kyoung-Shin Choi

**Related Technologies**

- See WARF reference number P140325US01 for information about the researcher's high performance $BiVO_4$ photoanode technology.

**Related Intellectual Property**

- View Divisional Patent in PDF format.

**Publications**

- Cha H.G. and Choi K-S. 2015. Combined Biomass Valorization and Hydrogen Production in a Photoelectrochemical Cell. Nature Chem. 7, 328-333.
- Read a news story about this technology

**Tech Fields**

- Clean Technology : Biobased & renewable chemicals & fuels
- Clean Technology : Solar, wind & water technologies

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854