

# 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<sub>2</sub>, 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**

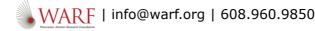
• Production of FDCA and DFF - important building block molecules used to make a variety of materials and chemicals

## **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

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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<sub>4</sub> photoanode technology.

### **Related Intellectual Property**

<u>View Divisional Patent in PDF format.</u>

### **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
- <u>Clean Technology : Solar, wind & water technologies</u>

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

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