csurf
Technology Transfer Office

Colorado State University

Glucose/Xylose Sensor for Cellulosic Biomass Processing

A critical step in cellulosic biomass processing is hydrolysis where cellulose and hemicellulose is broken down into fermentable sugars, primarily glucose and xylose. Monitoring this breakdown is critical for efficient and complete conversion. The current state-of-the-art glucose sensors for monitoring this application have been unreliable, have a high limit of detection (mM) limiting process monitoring to end-products, are not amendable to online monitoring, and cannot detect xylose or any other breakdown component of hemicellulose. The result is that most analysis is performed by High Performance Liquid Chromatography (HPLC), a device that is expensive, requires trained and skilled personnel, not adaptable to online monitoring, and gives results in hours to days. Thus, microchip capillary electrophoresis technology developed at Colorado State University can be configured for rapid, unattended, online analysis of most carbohydrates including glucose and xylose. Data show low limits of detection (mM) of glucose and xylose using the CSU microchips and procedures have been developed for isolation and quantification of glucose and xylose from real biomass hydrolysis samples.

ID: CSURF 08-058

Patent information
Patent pending.

Inventor Information
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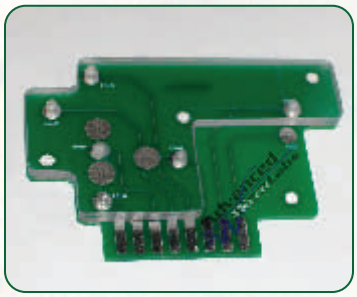
The novel CSU sensor system will measure glucose and xylose concentrations in cellulosic biomass processing using lab-on-a-chip technology for the routine monitoring of these complex samples. This technology lends itself to the production of mass produced, inexpensive and disposable microchips that can measure many analytes in a single sample. In addition, the CSU technology brings a unique detection capability to the field of Pulsed electrochemical Detection (PAD). PAD is a routinely utilized mode for detection of carbohydrates, thiols, alcohols, and amino acids in conjunction with standard laboratory separation methods such as HPLC. However, PAD has been demonstrated by the CSU lab-on-a-chip type devices.



We anticipate a device could be installed within a production facility for online monitoring of a plant's saccharification process. The device would monitor the process through periodic determinations of glucose and xylose during a typical 72 hour process, allowing the process managers to make process control adjustment and determine endpoints. Disposable "lab-on-a-chip" microchips will be capable of running multiple analyses on a single chip and would be replaced approximately once a week. The device would be user-friendly, with results being automatically reported to a central computer and require minimal maintenance – approximately 1 hour/week for microchip/filter replacement and recalibration. We conservatively estimate that online monitoring will increase the average yield 2% through better management of the yield variation – leading to decreased production costs.

Features and Benefits

- Novel sensor system to measure glucose and xylose concentrations in cellulosic biomass processing.
- An equivalent HPLC/PAD detection system using CSU's lab-on-a-chip technology.
- Rapid, unattended, online analysis of most carbohydrates including glucose and xylose.
- Inexpensive and disposable microchips that can measure many analytes in a single sample.
- Low limits of detection (mM) of glucose and xylose from real biomass hydrolysis samples.

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