

Disposable Electrochemical Paper Microfluidic pH Sensor

(OTT ID 1372)

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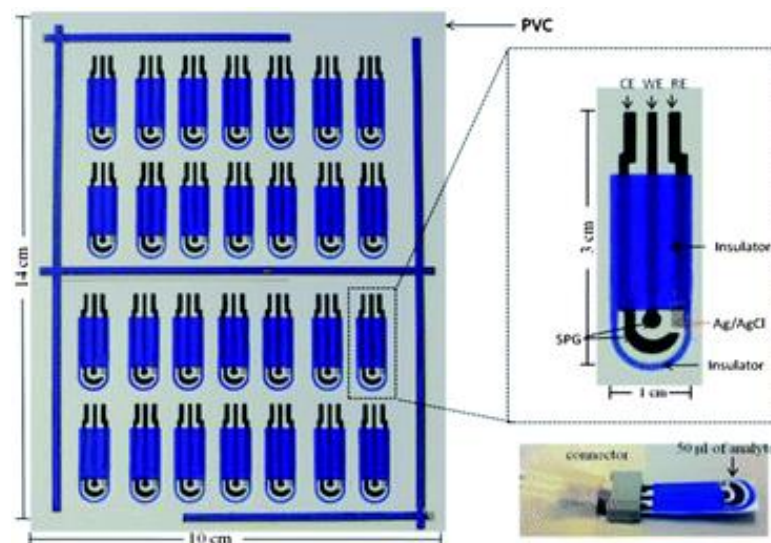
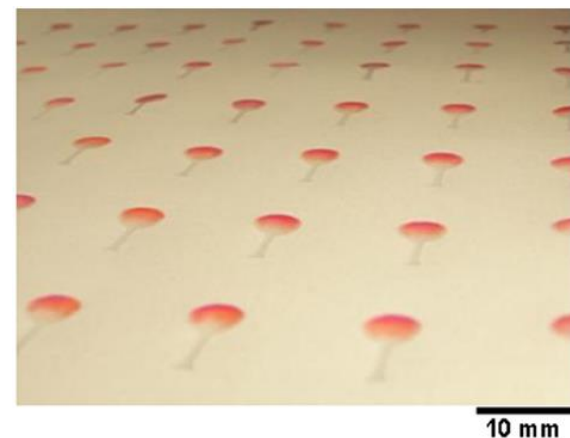
Problems With Current pH Detection:

- With pH paper, NOT possible to tell the exact pH
- With pH paper, NOT for color-blinded researchers
- With pH meters, accuracy is precise but, devices are very expensive
- With pH meters, devices require maintenance and care before, during and after use
- With pH meters, large volumes of liquid must be tested for results

Solution:

- Combine the accuracy of a pH meter, while using disposable, inexpensive, and easy to use test paper like those used in pH strips into a multi-use disposable pH paper sensor

- Miniaturized/portable
- Low cost
- Eco-friendly
- Scale up



- **More Accurate** – Increased pH testing accuracy read to the second decimal.
Measures a very wide pH range
- **Easy to Read**– Digital readout for easy quick and easy viewing
- **Portable** – Compact handheld electrode for convenient usage
- **Inexpensive**– Single use disposable paper used with multi-use electrode for low cost measurements
- **Easy to Use** – Only a small sample is needed for testing
- **Minimal Contamination**-The patterned paper fluidic channel can minimize contamination

Market:

- Global laboratory products market was estimated as a \$38 billion dollar industry in 2012, with large markets in the U.S (\$14.9 billion), China (\$1.3 billion) and India (\$1.4 billion)
- With respect to changing technology, it is estimated that 20% of all instrumentation and equipment in the modern research laboratory will need replacements within the next five years
- Many of the instruments that will need replacements include detectors and sensors. The industry is forecasted to grow 1.8% in 2014 and continue to grow an additional 2.2% in 2015, with an expected five-year compound annual growth rate (CAGR) of 11.2%

Intellectual Property

- PCT patent application filed WO 2016/090176

Partnering

- This technology is part of an active and ongoing research program and is seeking partners for development of the final product. It is available for developmental research support/licensing under either exclusive or non-exclusive terms.

Digital Display of pH Sensor

Figure 1. Sample output of pH sensor, measured to two decimal places

pH8



pH10



Figure 1

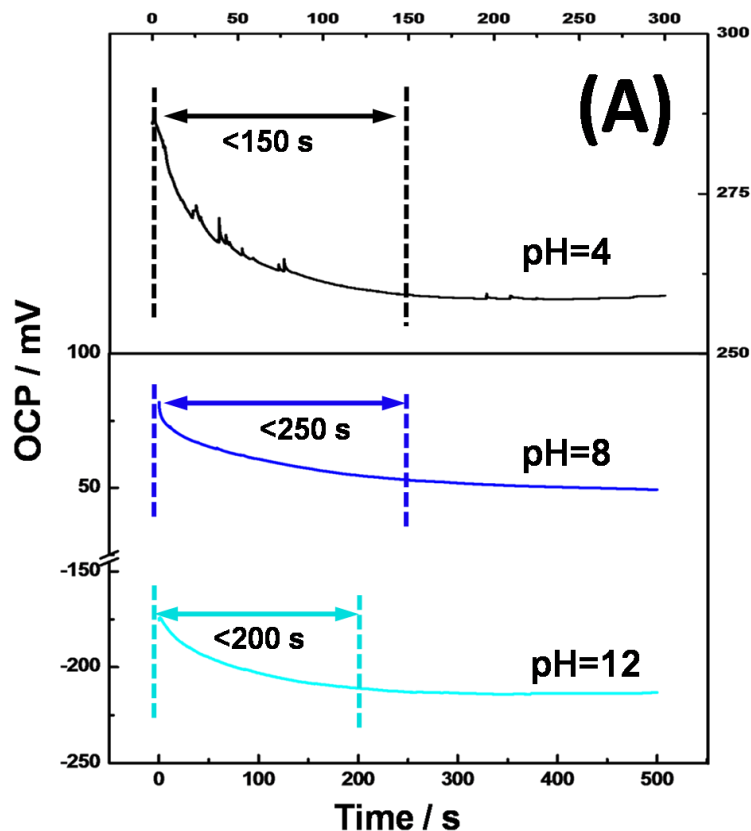


Figure 1. Potential-time curves of ERGO-IrO₂ SPEs at pH 4, 8 and 10 in B-R buffers

Britton-Robbison Buffer

Figure 1

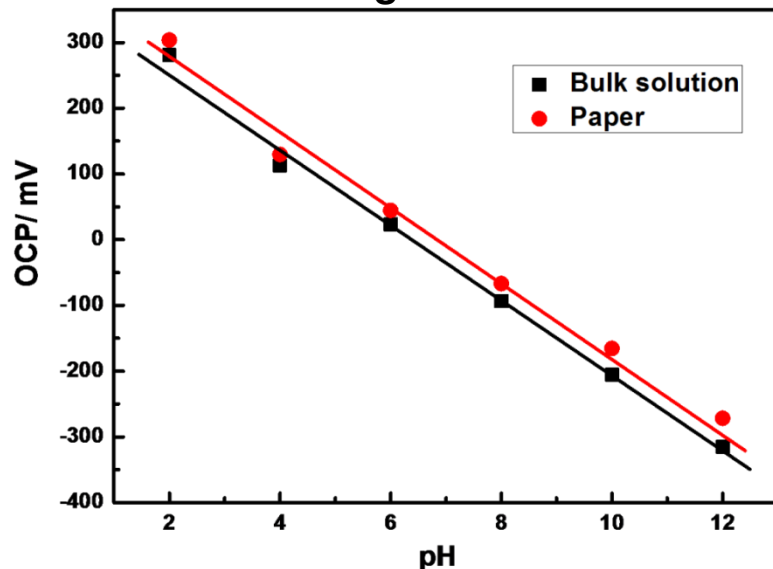
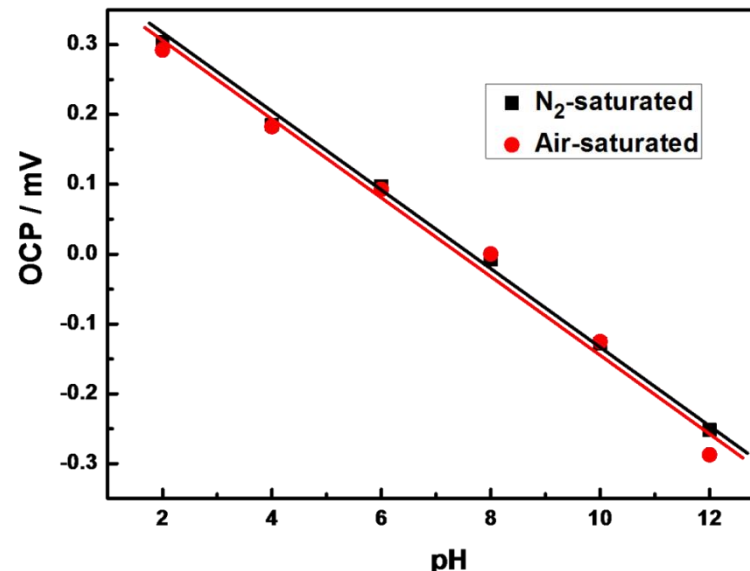


Figure 2



- **Figure 1.** pH measurements are the same in bulk solution and in the paper substrate
- **Figure 2.** O₂ doesn't affect the measurement because it's similar in air and N₂ conditions

Figure 1

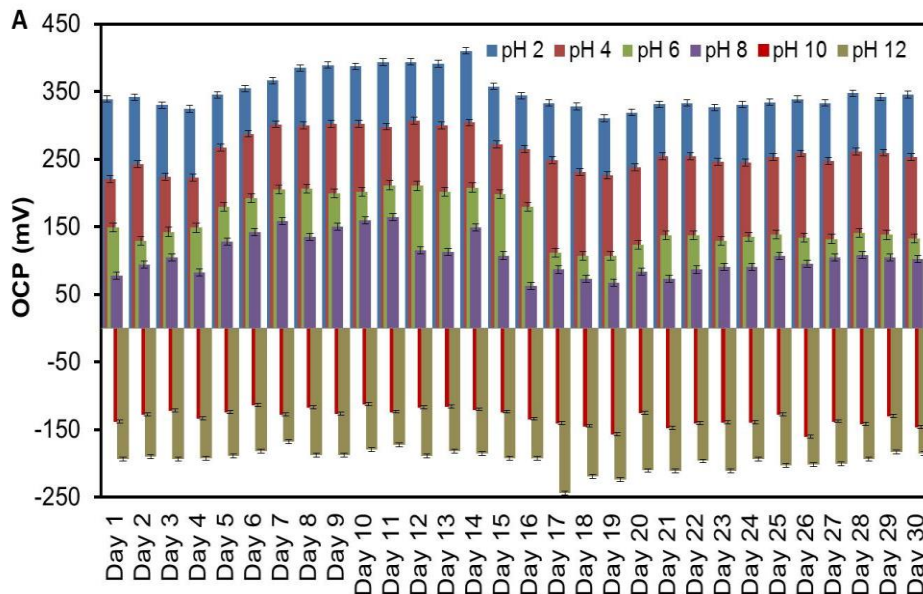
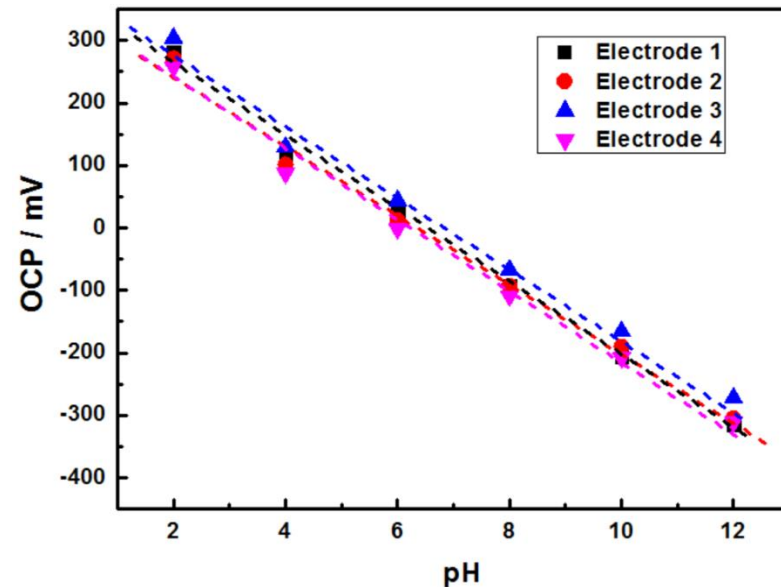


Figure 2



- **Figure 1.** Shows the consistency and stability of the pH device over one month, sensor-to-sensor variation is low
- **Figure 2.** When used with different electrodes, measurements are similar

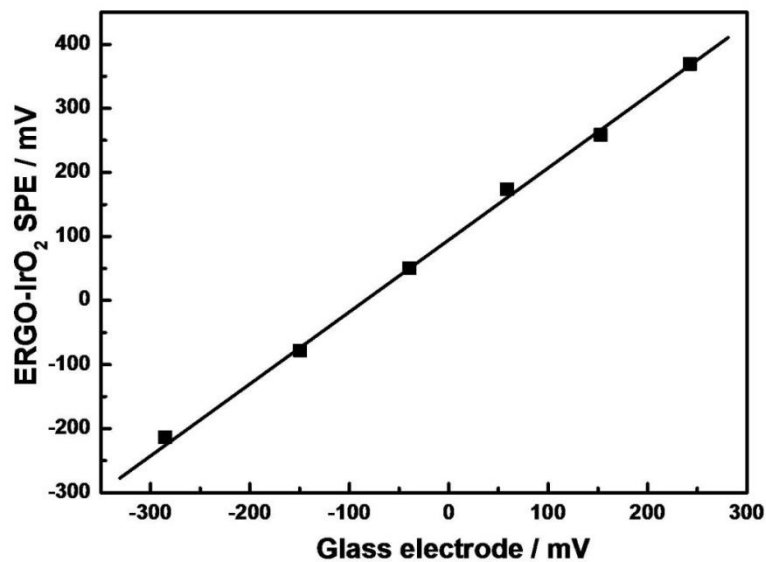


Figure 1. Correlation with a standard commercial glass electrode at a pH meter

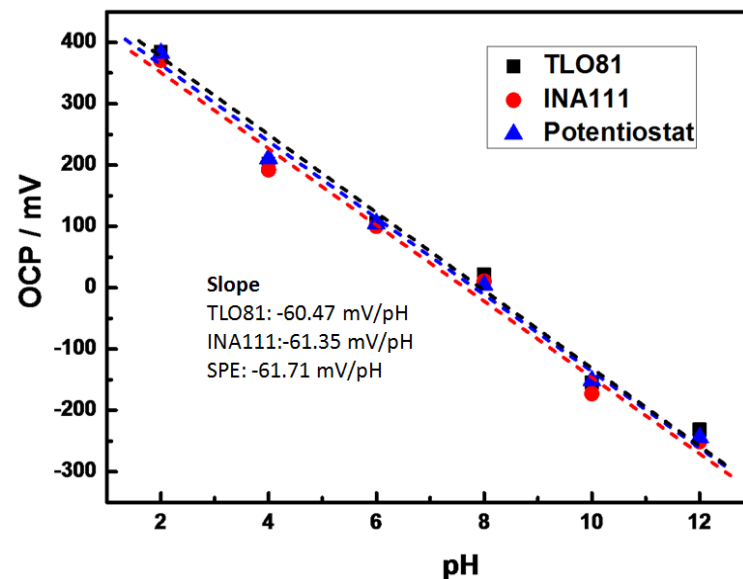


Figure 2. Five different electrodes prepared in parallel. Sensor-to-sensor variation is low

- The inventors have developed an electrochemical pH paper sensor for use in numerous environments including laboratory use, pharmaceutical use and food science
- By combining the sensor with screen-printed technology and a hand-held reader, the device offers an accurate and precise pH sensor that is also inexpensive, portable (miniaturized) and eco-friendly
- The hand-held electrochemical reader and screen-printed electrodes can be used as disposable or can also be reused several times, the paper test strip for liquid samples is for one-time-use which serves for sample delivery and storage

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