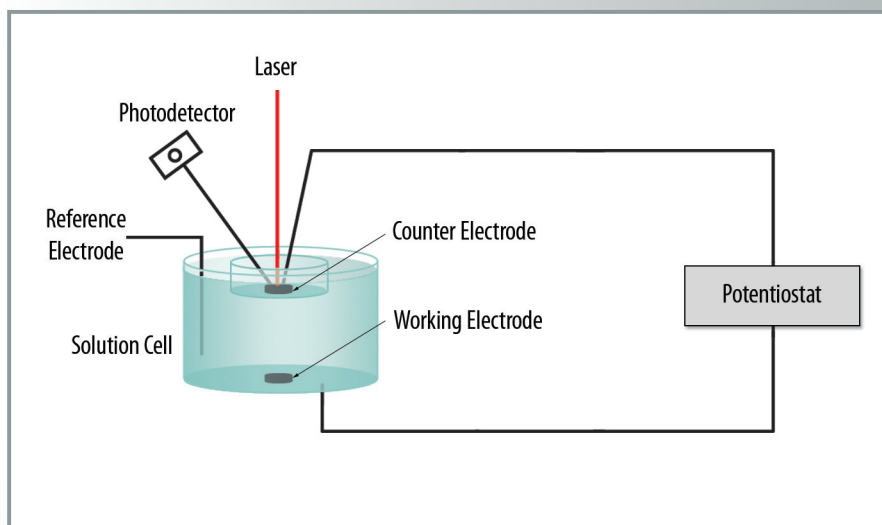


# Microcantilever Counter Electrode Electrochemical Sensor in a Three-Electrode Cell

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## Technology Summary

Researchers at ORNL have invented a compact, highly accurate system to detect and measure chemicals in solution. The device can be used to detect ions and other electroactive species, hostile biological agents, and protein fragments. The device is a three-electrode cell in which the counter electrode is a microcantilever. The entire sensor (or an array of sensors) could be fabricated as an integrated circuit on a silicon substrate.

The microcantilever's extreme sensitivity makes it an excellent chemical and biochemical sensor. In this invention, the cantilever is made conductive and chemically selective by coating one surface with a metal. The three-electrode configuration overcomes the limitations of previous designs, in which the cantilever is also the working electrode, by separating the sensor from the reactions at the working electrode.

Piezoresistance causes the cantilever to bend when current is applied to it. The presence of chemicals adhered to its surface affects the extent of its deflection. Chemicals are identified by the effect that they have on the cantilever's deflection, as determined by changes in resistance and in the angle of reflection of a laser beam trained on the cantilever's surface.

## Advantages

- Handles very small sample volumes
- Extremely sensitive and selective
- Tunable by varying the dopant applied to the cantilever
- Built with established semiconductor fabrication techniques

## Potential Applications

- Detect ions or other electroactive species
- Detect hostile biological agents
- Detect protein fragments
- Use as a detector for scanning tunneling microscopy
- Aid understanding of double layers or diffusion layers in electrolyte solutions
- Mechanical ammeter in electrochemical cells
- Water quality analysis

## Patent

Thomas G. Thundat and Gilbert M. Brown, *Electrochemical Sensor Having Suspended Element Counter Electrode and Deflection Method for Current Sensing*, U.S. Patent 7,716,965, issued May 18, 2010.

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