

# A Silicon Microneedle Array Atmospheric Pressure Plasma Ionization Source for Real-Time Trace Gas Chemical Analysis

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## ABSTRACT

Researchers at the University of California, Davis have developed an atmospheric pressure ionization source that employs an ordered array of micro-needles designed to ionize sample components.

## FULL DESCRIPTION

This technology provides an ionization device operating at atmospheric pressure that utilizes an ordered array of micro-needles to flow and ionize samples. The needles act both as microfluidic conduits and ionization points where electrical discharge occurs to generate atmospheric plasma across a sub-millimeter gap between the needle array and a cathode. The device can be integrated with mass spectrometry or other detection systems and can be constructed with selectable needle array configurations, coatings, and electronic control to optimize performance and durability.

## APPLICATIONS

- ▶ Mass spectrometry sample ionization for chemical, environmental, and pharmaceutical analysis.
- ▶ Portable analytical devices for field testing and diagnostics.
- ▶ Microfluidic lab-on-a-chip systems requiring integrated ionization.
- ▶ Plasma-based ionization technologies for rapid chemical sensing.
- ▶ Research tools in atmospheric pressure plasma chemistry and analytical instrumentation.

## FEATURES/BENEFITS

- ▶ Operates at atmospheric pressure.
- ▶ Reduces voltage and power requirements through a sub-millimeter ionization gap.
- ▶ Enables portable, compact design for field and laboratory use.
- ▶ Minimizes component wear with selectively activated needle arrays for consistent ionization.
- ▶ Integrates dual-function micro-needles as both fluid conduits and ionization sites.
- ▶ Customizes chemical environments with tailored needle coatings.
- ▶ Enhances fluid flow and robustness with improved aerodynamic needle structures.
- ▶ Maintains compatibility with standard detection methods, such as mass spectrometry.
- ▶ Lowers power consumption and voltage needs for ionization sources.
- ▶ Extends component lifespan by minimizing wear through selective needle activation.
- ▶ Streamlines efficient ionization of samples in portable, compact formats.

## CONTACT

Byron N. Roberts  
[bnroberts@ucdavis.edu](mailto:bnroberts@ucdavis.edu)  
 tel: 530-754-8689.



## INVENTORS

- ▶ Chew, Bradley
- ▶ Davis, Cristina E.
- ▶ Gibson, Patrick
- ▶ McCartney, Mitchell M.

## OTHER INFORMATION

### KEYWORDS

atmospheric pressure  
 ionization, cathode,  
 microfluidic needles,  
 mass spectrometry,  
 needle array, plasma  
 ionization, portable  
 ionizer, sub-millimeter  
 gap, tungsten coating,  
 wearable ionization

### CATEGORIZED AS

- ▶ **Materials & Chemicals**
- ▶ **Electronics Packaging**

- ▶ Adapts ionization parameters flexibly with customizable needle arrays and coatings.
- ▶ Enables precise ionization in microfluidic environments without sample dilution.

- ▶ **Nanotechnology**
  - ▶ Tools and Devices
- ▶ **Sensors & Instrumentation**
  - ▶ Analytical

## PATENT STATUS

Patent Pending

## RELATED CASES

2026-402-0

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Heated Dynamic Headspace Sampling Device for Volatile Organic Compounds \(VOCs\) from a Surface](#)
- ▶ [Exhaled Breath Condensate Biomarker Database](#)

### University of California, Davis

### Technology Transfer Office

1 Shields Avenue, Mrak Hall 4th Floor,  
Davis, CA 95616

Tel:

530.754.8649

[techtransfer@ucdavis.edu](mailto:techtransfer@ucdavis.edu)

<https://research.ucdavis.edu/technology-transfer/>

Fax:

530.754.7620

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