



## SCALABLE PLASMA ACTIVATION SPRAY (PAS) PLATFORM

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### HIGHLIGHTS

- High-Throughput Droplet-Based Reactor
- Rapid Multi-Target Purification

### OPPORTUNITY

Pharmaceuticals, toxic industrial chemicals, and pathogens in water threaten ecosystems and public health worldwide. Traditional cold plasma treatment relies on bubbling gas through bulk water, but this method is slow, inefficient, and unstable. To overcome this, researchers at the University of Alberta created a continuous Plasma Activation Spray (PAS) system. By spraying water into fine micro-droplets directly inside a cold plasma zone, the platform speeds up gas-liquid mixing, capturing high concentrations of active molecules before they break down. This solution offers:

- **Tunable Chemical Selectivity:** By adjusting spray droplet size and reactor geometry, operating regimes can be switched to favor either nitrogen-centered species for specialized treatment/agriculture or hydrogen peroxide accumulation for chemical oxidation.
- **High Energy Efficiency at Scale:** Achieves energy yields greater than 1.84 mmol/MJ for nitrogen species and greater than 2.05 mmol/MJ for hydrogen peroxide at full 1-liter working volumes.
- **Scalable Industrial Infrastructure:** Engineered as a modular, continuous-flow platform, it can be used for high-volume wastewater treatment in municipal, agricultural, and industrial applications.

Researchers developed fully functional prototype reactors and validated them across comprehensive laboratory and liter-scale trials. The system achieved over 95% degradation of organic dyes within 6 minutes, rapid breakdown of stubborn antibiotic micropollutants, and a complete  $\geq 6$ -log reduction of both Gram-negative and Gram-positive bacteria within 15 to 30 minutes.



## COMPETITIVE ADVANTAGE

- **Inverted Gas-Liquid Transport Architecture:** It facilitates the dispersion of water droplets into the reactive plasma gas phase, instead of injecting gas into bulk liquid. This increases the interfacial contact area and reduces diffusion distances, allowing for the rapid capture of short-lived active species.
- **Multi-Electrode Spatial Coverage:** Strategically designed multi-needle layouts ensure the active plasma field completely overlaps with the falling droplet curtain, eliminating inactive zones and boosting energy efficiency by up to 180%.
- **Chemical-Free, Low-Cost Operation:** Operates at ambient temperature using air and electricity.

## IP STATUS

- Patent pending

## INVENTOR

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## MORE INFORMATION

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