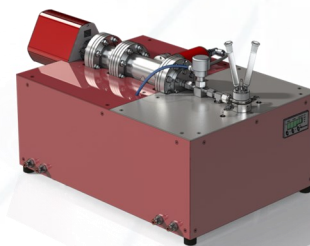


## Fully quantitative real-time and high sensitivity detection of volatile electrochemical reaction products



Effortless coupling of electrochemistry (EC) and mass spectrometry (MS) for researchers. SpectroInlets' EC-MS system is the first truly quantitative turnkey solution for fast, reliable and sensitive time-resolved detection of volatile electrochemical products sampled directly from a liquid electrolyte. The unique micro chip-based inlet system is optimized to transfer the exact number of molecules required for optimal MS sensitivity, thereby avoiding differential pumping and associated quantification challenges. Due to its extraordinary sensitivity, the EC-MS system can detect the entirety of the volatile molecules desorbing from an electrode during a single electrochemical turnover.

### Relevant applications

- Fuel cell reactions (e.g. HOR/MOR)
- Water splitting (e.g. HER/OER)
- Organic (electro-)synthesis (e.g. CORR, hydrocarbon upgrading)
- Model studies (e.g. correlating desorption phenomena with theory)
- Nitrogen reduction (N<sub>2</sub>RR)
- Battery research (solvent decomposition)
- General electrocatalysis and -chemistry
- Electrolyte stability studies
- Isotope labeled experiments (e.g. for reaction pathway studies)

### System benefits

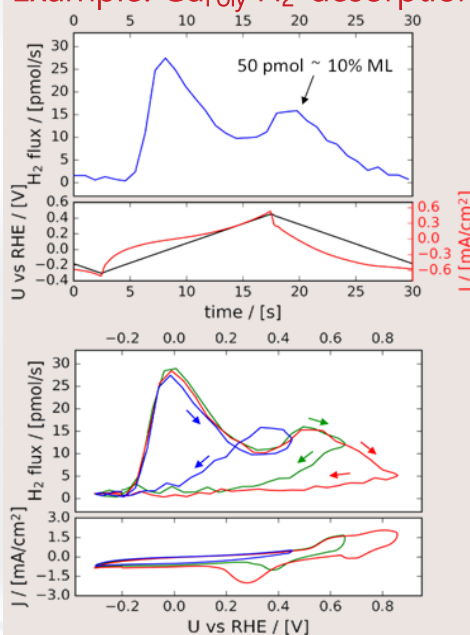
**State-of-the-art chip-based inlet:** Highly tailored analyte sampling and molecular flow for true quantitative analysis, fast-time response, high sensitivity with 100% collection of volatiles to the detector.

**High level control:** The membrane system allows gas reactants and composition to be changed rapidly to match potentiodynamic settings, giving unprecedented experimental control with the EC-MS system. The high dynamic range of both the potentiostat and MS combined with the low EC-cell volume yields excellent system response with a broad detection range.

**Electrode flexibility:** Turnkey system allowing for direct communication with EC-lab. The system is designed for investigation of standard ( $\varnothing=5$  mm) electrodes (e.g. poly- or single-crystals, supported nanoparticles or thin film samples) while allowing for custom cell/electrode designs.

**User-friendly software (SW) solution(s):** System SW (Zilien) allows for complete MS control and communication with EC-lab; easing setting up experiments. Additionally, an open-source Python packages (ixdat) developed for and by researchers allows for easy data processing of the produced text data files.

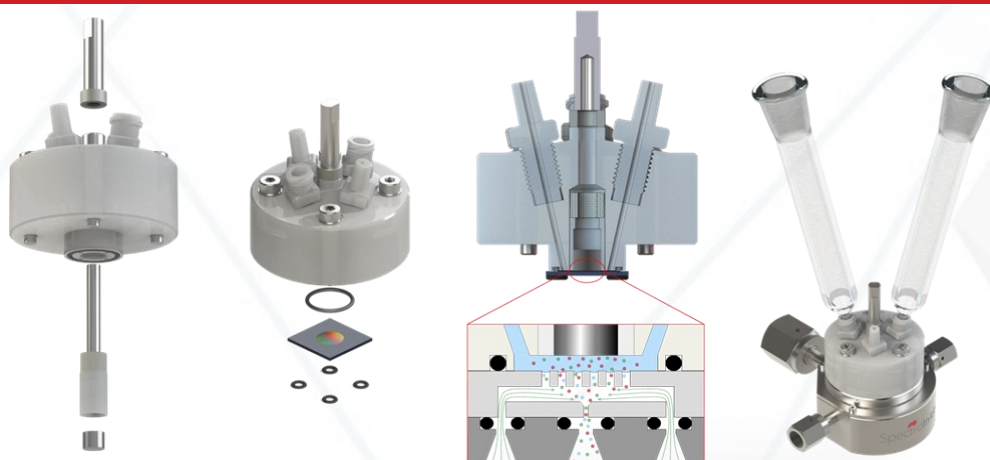
### Example: Cu<sub>Poly</sub> H<sub>2</sub>-desorption



Anodic H<sub>2</sub>-desorption on polycrystalline Cu in 1.0 M KHCO<sub>3</sub> @50 mV/s at 23 °C. **Top:** H<sub>2</sub> ( $m/z=2$ ) signal and co-plotted  $I$ - $V$  data plotted vs. time. **Bottom:** H<sub>2</sub> ( $m/z=2$ ) signal and electrode current plotted vs. potential. Reprinted with permission from D.B. Trimaco's 2017 PhD thesis.

# SpectroInlets

Enabling real-time analysis



	PROPERTY	SPECIFICATIONS
EC SYSTEM	POTENTIOSTAT	Bio-Logic SP-200 with EIS capability (optional)
	DYNAMIC CURRENT RANGE	±500 mA to 10 nA @760 fA resolution (standard)
	POTENTIODYNAMIC RANGE	±10 V @down to 1 µV resolution
	SOFTWARE	EC-lab
MS SYSTEM	MASS SPECTROMETER	Pfeiffer Vacuum
	VACUUM PUMPS	Turbomolecular pump (Pfeiffer Vacuum), Scroll pump (Edwards)
	MEASURING SPEED	1 ms/amu - 16 s/amu
	MASS RANGE	1-200 amu (optionally 1-300 amu) with 0.5-2.5 amu resolution
	MS DETECTOR	Faraday Cup and Continuous Secondary Electron Multiplier
	SOFTWARE	PVMassSpec (additional tool for MS maintenance)
COMBINED EC-MS SYSTEM	PRODUCT DETECTION RANGE	1 mA to 1 nA equivalent (@100% collection efficiency)
	SENSITIVITY	Down to 0.5‰ of a monolayer within 0.5 s
	RESPONSE TIME	>16 ms (dependent on product volatility and electrolyte used)
	COLLECTION EFFICIENCY	100% of volatiles
	EC-CELL MATERIAL	PCTFE with PTFE U-cup system (adaptable)
	THIN-LAYER CELL VOLUME	8 µL (ca. 400 µL electrolyte required for cell filling)
	DIMENSIONS	450 mm × 790 mm × 337 mm (w/o cell's Luggin adapters)
	POWER	110/220/240 V AC, 50/60 Hz, 1.2 kVA
	MIN. GAS REQUIREMENT	2 bar pressurized air and any N5.0 inert gas
	GAS INLETS	4 (VCR connections)
	SOFTWARE	Zilien (easy data processing e.g. using Python package: ixdat)
	INTERFACE CONNECTION	USB 2.0 to any Windows (10 and 11) operated computer
	OPERATING CONDITIONS	0-70 °C in 0-80% rel. humidity in ambient conditions
CERTIFICATIONS	CE	

The EC-MS system has been specially designed to overcome the challenges of conducting electrochemical experiments coupled with mass spectrometry. Our qualified staff of engineers and electrochemists will readily assist you with installation, training, application development and post-sales support. Please contact [info@spectroinlets.com](mailto:info@spectroinlets.com) for further information.

