

# Analytical Instrumentation Specialist — Technical Portfolio

Precision electrochemistry · ISO 17025 consulting · Custom electrode fabrication

Marcos Daniel Bueno Rosa, BSc Chemistry · Calgary, AB, Canada

[schrodinger.ca](http://schrodinger.ca) · [md@schrodinger.ca](mailto:md@schrodinger.ca) · [LinkedIn](#)

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## Expertise

Discipline	Description
<b>pH Measurement</b>	Proprietary glass membrane formulation (hand-blown, $-10^{\circ}\text{C}$ to $135^{\circ}\text{C}$ , 10 bar). Electrode body fabrication in HDPE, Polycarbonate, PEI (Ultem), PTFE, AISI 304. Buffer preparation from primary reagents (NRC/NIST-traceable). Multi-point standardization in harsh environments (high-temperature, saline, organic solvents). ASTM D1293 compliance.
<b>ORP / Redox</b>	Platinum and gold electrode fabrication. Combined (ORP + reference) or independent configurations. Single and double junction, reloadable or sealed. Reference selection: Ag/AgCl (KCl 3M + AgCl sat.), Hg/Hg <sub>2</sub> Cl <sub>2</sub> (KCl sat.). Eh-pH diagrams, quinone calibration ( $\pm 468$ mV, $25^{\circ}\text{C}$ ). $-10^{\circ}\text{C}$ to $135^{\circ}\text{C}$ , 10 bar.
<b>Ion-Selective (ISE)</b>	Crystalline: F <sup>-</sup> (LaF <sub>3</sub> ), S <sup>2-</sup> /Ag <sup>+</sup> (Ag <sub>2</sub> S), Pb <sup>2+</sup> (PbS/Ag <sub>2</sub> S), Cl <sup>-</sup> /Br <sup>-</sup> /I <sup>-</sup> (AgX), CN <sup>-</sup> (AgI/Ag <sub>2</sub> S), Cu <sup>2+</sup> (CuS/Ag <sub>2</sub> S). Gas/Severinghaus: NH <sub>3</sub> , CO <sub>2</sub> . Polymeric (PVC+ionophore): Ca <sup>2+</sup> , K <sup>+</sup> , Na <sup>+</sup> , NO <sub>3</sub> <sup>-</sup> , BF <sub>4</sub> <sup>-</sup> . Nernst characterization (slope, offset), interference compensation.
<b>Dissolved Oxygen</b>	Clark galvanic cell fabrication (silver cathode / lead anode, PTFE membrane). Calibration against certified reference gases (0%, 100% O <sub>2</sub> ). Membrane maintenance protocols for biofilm-prone environments. Optical DO (LDO): evaluation and third-party specification — not manufactured in-house.
<b>Conductivity / EC / TDS</b>	2-electrode and 4-electrode cell design (platinum and/or graphite). K=0.1/1.0/10, range 0.01 $\mu\text{S}/\text{cm}$ to 200,000 mS/cm. Cell constant determination per ISO 7888. Temperature compensation ( $\alpha$ -factor), cell fouling, electrode coating effects.

## Capabilities

### Design & Fabrication

- Glassblower: proprietary glass membranes, electrochemical cells, custom glassware
- Precision machinist: manual lathe — micro-machining of electrode bodies, PTFE junctions, sensor housings
- Custom PCB with dedicated analog IC, high-impedance buffer ( $>10^{12} \Omega$ ), galvanic isolation
- Proprietary PTFE porous junctions ( $-10^{\circ}\text{C}$  to  $135^{\circ}\text{C}$ , 10 bar)
- Counter-electrodes: glassy carbon, platinum, gold
- Complete electrochemical cells for voltammetry
- 3D-printed prototyping for rapid iteration

### Embedded Systems & Firmware

- Languages: C, C++, Python, MicroPython
- Platforms: ESP32, custom PCB (FreeRTOS or bare-metal)
- Protocols: Modbus RTU/TCP, HART, MQTT, OPC-UA
- 4-20 mA transmitter design with galvanic isolation
- ADC linearization, Nernst correction in firmware
- OTA updates, IP65/67/68+ enclosures
- SCADA/DCS integration

### Calibration & Metrology

- ISO 17025 implementation consulting (not auditor — no ILAC/IAF/CGCRE credential)
- ISO 17034 reference material advisory
- GUM uncertainty budgets (Type A + Type B)
- Traceability: NRC (Canada), NIST (US), Inmetro/RBC (Brazil)
- AEPA testing protocols and CSA alignment
- ASTM D1293 (pH), EPA 150.1 (conductivity)
- Proficiency testing programs (z-score analysis)

### Digital Metrology Platforms (SaaS)

- 12 production SaaS platforms built solo
- 1,600+ API endpoints, 648 database tables, RLS 100%
- LIMS + ELN + QMS: sample lifecycle, chain of custody, CAPA, audit trail, CoA with QR
- Trust Score: proprietary algorithm — drift-based calibration prediction
- ERP (608 endpoints), Healthcare (TISS 3.05), LMS, Sales Intelligence
- OmniDesk (omnidesk.cloud): ERP/accounting for Canadian SMBs, bilingual EN/FR, GST/HST
- Labrix (labrix.ca): LIMS for Canadian labs, SCC/CALA format, NRC traceability
- AI Engine: 125 crews, 140 agents, multi-LLM (Groq/OpenAI/Anthropic)
- Stack: Python/FastAPI, TypeScript/Next.js, PostgreSQL, Docker, Caddy, Redis

### Cybersecurity & OT Pentest

- Red Valkyrie (redvalkyrie.ca) — continuous red-team platform
- OWASP ZAP automated scanning, penetration testing
- SOC 2 evidence automation, CCCS reporting
- Red-team tested: 39/39 attacks blocked on own infrastructure
- OT/SCADA/ICS security — directly relevant to O&G and utilities
- Bill C-26 / PIPEDA alignment for Canadian critical infrastructure
- Custom Linux distribution (RedValkyrieOS): 3 variants (Pentest, Stealth, Server)

### Installation & Support

- Remote-first consulting (all Americas)
- On-site: Canada & select US locations
- Sensor installation, zero-point verification, commissioning
- Operator training (EN, PT-BR, ES, FR)
- Maintenance protocols, spare parts management
- Legacy instrument troubleshooting and repair
- Production capacity: 200 units/day solo, ~2 weeks lead time

## Industries Served

Sector	Applications
Oil & Gas (Alberta)	SAGD produced water, sour water H <sub>2</sub> S, amine treating, corrosion control, custody transfer conductivity, downhole sensor development
Water Treatment & Municipal	Drinking water pH adjustment, chlorine residual (ORP), disinfection by-product control, wastewater aeration dosing (DO), discharge compliance
Sugar & Ethanol	High-Brix pH measurement, fermentation monitoring, CIP/SIP resistant electrodes, vinasse treatment, evaporator stations
Mining & Mineral Processing	Flotation reagent pH control, tailings pond monitoring, acid mine drainage (AMD) assessment and remediation
Environmental Labs & Monitoring	River/lake quality assessment, groundwater contamination tracking, atmospheric precipitation analysis, sediment pore-water profiling
Industrial Process Labs	Food & beverage fermentation, pharmaceutical water systems, petrochemical, electroplating solution chemistry, feed-stock analysis
Nuclear & Research	Standard electrodes (glass/PTFE) for nuclear applications, electrochemical cells for voltammetry research (CNPEM/SIRIUS, LNLS, CNEN, CDTN, INPE)

## Instruments & Equipment

Category	Specifications
Benchtop Analyzers	Multi-parameter water quality analyzers (pH, ORP, DO, conductivity, ISE) with data logging and USB export. Custom PCB, dedicated analog front-end.

<b>Field Instruments</b>	Portable pH, ORP, DO, conductivity probes for harsh environments (mining, O&G, construction). IP65/67/68+.
<b>Industrial Transmitters</b>	4-20 mA and Modbus RTU/TCP transmitters. NEMA 4X / IP67. AISI 304 or polycarbonate enclosures. Configurable hysteresis, averaging, alarm outputs.
<b>Multi-parameter Analyzer (Roadmap)</b>	pH/ORP/conductivity/TDS/salinity/ISE/DO Clark — benchtop + process. Designed from zero, custom analog IC.

## Select Clients (Brazil, verified)

[Petrobras CENPES](#)
[PQ Sílicas Brazil](#)
[Vale](#)
[ArcelorMittal](#)
[Copel](#)
[SABESP](#)
[Coca-Cola](#)
[Nuclep](#)
[Usina Coruripe](#)
  
[Oxiquímica Agrociência](#)
[CNPEM/SIRIUS](#)
[LNLS](#)
[CNEN](#)
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[INPE](#)
[IPT](#)
[PUC-RS](#)
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## Technology Stack

[Python](#)
[FastAPI](#)
[TypeScript](#)
[Next.js](#)
[React](#)
[PostgreSQL](#)
[Supabase](#)
[Redis](#)
[TimescaleDB](#)
[Docker](#)
[Caddy](#)
[N8N](#)
  
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