A CASE STUDY FROM
SPECTRO ANALYTICAL INSTRUMENTS

SPECTRO ARCOS helps energize Pure Lithium's development of next-generation batteries

SPECTRO ARCOS Advantages

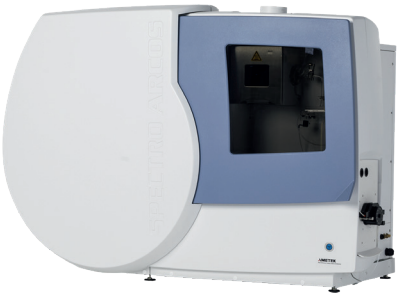
- Flagship ICP-OES benchtop spectrometer for advanced elemental analysis
- Simultaneous spectrum capture in the 130-770 nanometer (nm) wavelength range, with up to 5x more sensitivity than echelle-based systems and best-in-class performance in the UV/VUV ranged
- High-speed (3-4 minute) analysis at parts per billion (ppb) levels in the solid, for high-productivity research and development
- No expensive, high-maintenance external chiller
- No argon purging
- Advanced software / ease of use
- Lower total costs of ownership



The race is on! What breakthrough battery technologies will power the world's next generation of energy-hungry devices, from cellphones to electric vehicles? One likely winner: the rechargeable lithium metal batteries now being commercialized by startup Pure Lithium in Charlestown, Massachusetts, USA.

A conventional lithium-ion (Li-ion) battery comprises a graphite anode, a lithium metal oxide cathode, and an electrolyte of lithium salts in an organic solvent — and includes expensive materials such as cobalt and nickel. By contrast, Pure Lithium's innovative design uses a pure lithium metal anode; vanadium cathode; and polymer-based electrolyte. And it requires no cobalt or nickel. Additionally, the company's proprietary process can directly extract high-purity lithium metal — safely, cheaply, and sustainably — from low-grade sources such as used lithium batteries or waste oil field brines. So it can vertically integrate lithium metal production "from the brine to the battery."

Result: a power source that's inexpensive, ultra-thin, non-flammable, and high-performance, with twice the storage capacity of Li-ion cells. Pure Lithium expects their lithium metal batteries to charge faster — and to last much longer, while costing three to five times less — than today's aging Li-ion designs.



The Challenges

This cutting-edge research and development demands fast, accurate, precise analysis of a wide range of sample materials, including line-rich metals. Which elements are present? In exactly what concentrations?

Dion Tsourides is Pure Lithium's vice president of analytical services, and head of the firm's onsite laboratory. He explains: "Our materials for analysis are coming from different internal groups: battery development, polymers, electrodeposition, assembly — so we need to run everything from aqueous to organic, to brines, to acidified metallurgical samples."

The versatility, precision, and robustness required set an extremely high bar for any spectrometer.

The Solution

As the company's planners designed their process, they considered several instruments from leading manufacturers. In early 2021, they installed a SPECTRO ARCOS *inductively coupled plasma optical emission spectrometry (ICP-OES)* analyzer.

"Graphite furnace AA and ICP mass spec aren't as good in these applications. There's no instrumentation better suited for this industry than ICP-OES — and SPECTRO ARCOS is the best ICP-OES. One of our founders called it the Ferrari of spectrometers," says Tsourides.

SPECTRO ARCOS is designed for the most advanced elemental analysis of metals, chemicals, petrochemicals, and other materials. It delivers exceptionally high continuous optical resolution over a wide spectral range — with full spectrum capture — plus stellar sensitivity. It also offers exclusive technologies such as no-purge UV-PLUS sealed gas purification and a no-external-cooling OPI-Air interface, as well as line-array CMOS-based detectors and a robust 2000-watt generator.

The analyzer is available in six versions. Pure Lithium uses an axial-view end-on plasma (EOP) model for high sensitivity. (Other available versions include a dual-side-on interface (DSOI) model that increases sensitivity while eliminating matrix effects, and a unique MultiView design that allows true axial-view and radial-view plasma observations in a single instrument.)

The Results

The SPECTRO ARCOS system is really amazing," says Dion Tsourides. "It's got superior and constant resolution over our working spectral range, for 30 or so elements of primary interest. Enough resolution in the infrared region to analyze lithium-6 and lithium-7! Which is really unheard of on any other ICP-OES.

"Then there's the ability to measure the nonmetals, particularly trace elements in the vacuum ultraviolet range, with high sensitivity. Chlorine, bromine, and iodine are of incredible importance to us. Sodium and potassium are absolutely critical. If I can't see the difference between 5 ppb and 7 ppb, I have a problem. Here again the SPECTRO ARCOS really has no competition.

"Also, the ability to capture the full spectrum by default — that separates SPECTRO from everyone else. So during a run, the software allows you to just go in there, investigate any anomalies, and then correct them on the fly.

"And the robustness of the system with that high-powered generator allows us to run all these organic materials — with little sample prep, and no need for an acid digestion or microwave. Plus we don't have to dilute the brines. So we get ultimate accuracy, because there's no preparation-related error.

"Finally, it's fully automated for any matrix. And the way it's designed, especially with no water chiller, it's really simple to clean when we switch sample types.

"So ultimately, with SPECTRO ARCOS we get fewer interferences, higher accuracy, and better analytical performance."

About Pure Lithium

Founded in 2019 in Charlestown, Massachusetts, USA, Pure Lithium is dedicated to sustainably commercializing lithium metal technologies for the next generation of batteries. Its innovative processes go from lithium salts to lithium metal electrodes in a single step. Surpassing traditional lithium-ion designs, the resulting lithium metal batteries will deliver greater cost effectiveness, higher performance, lighter weight, longer life, and ensured safety.

About SPECTRO

SPECTRO is one of the world's leading suppliers of analytical instruments. Its advanced analyzers use X-ray fluorescence spectrometry (XRF), optical emission spectrometry (ICP-OES, arc/spark OES), and inductively coupled plasma mass spectrometry (ICP-MS) technologies in providing accurate elemental analysis of materials for industry, research, and academia.

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