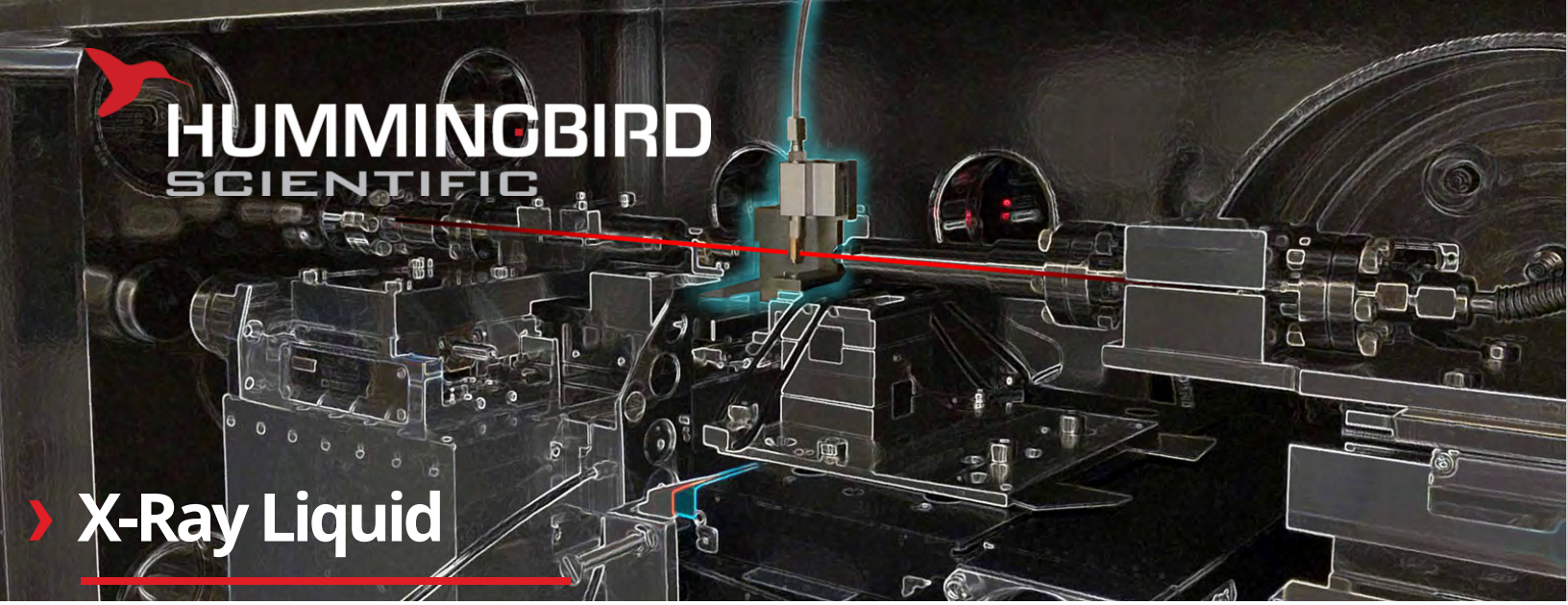
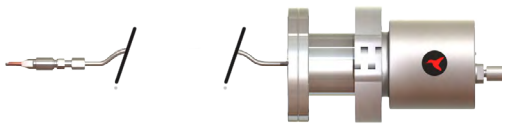


X-Ray Liquid



Technical Specs

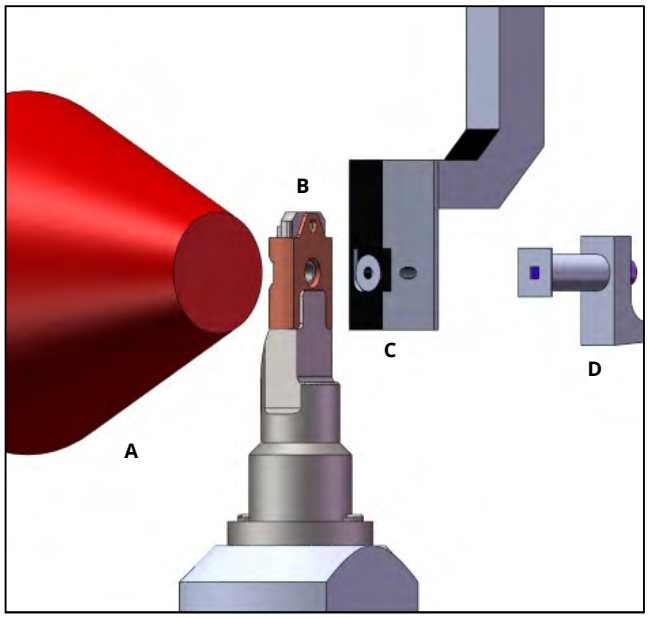
	1400 Series X-Ray
Number of Inlets	1 or 2 depending on model, single-outlet
Biasing Contacts	3 or 4 depending on model
Tubing Type	Replaceable microfluidic tubing
Delivery System	Variable-speed liquid delivery system
Tip Type	Standard TEM Sample Supports
Flow Type	Continuous or static-liquid flow
Microscope Compatibility	Custom integration

Contact us for Custom Configurations

How It Works

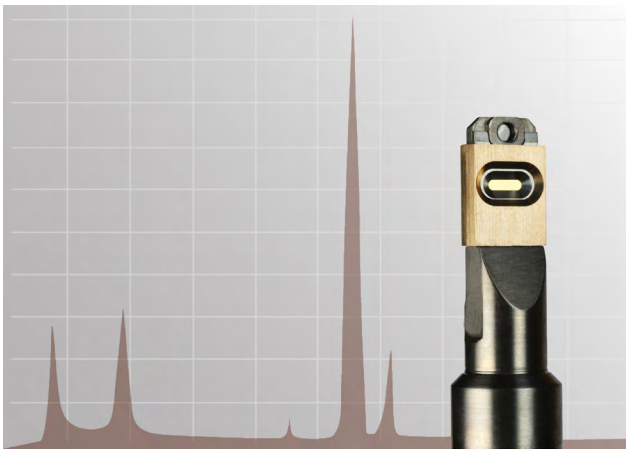
Hummingbird Scientific's x-ray liquid system encloses the sample within the liquid cell via a by a patented sealing mechanism, which protects it from the microscope chamber environment. Fluid and power are supplied to the tip through a customizable chamber interface and vacuum-sealed supply system. The microfluidic pump and optional power supply and potentiostat are located safely outside of the chamber. Hummingbird's two-chip fluid cell allows users to prepare their samples using the sample methods they would employ for any other electron transparent-membrane substrate.

Our liquid specimen holder features easy liquid-cell assembly and numerous safety features that protect your microscope's vacuum system from contamination and damage. Interchangeable tips and replaceable tubing enable researchers to perform controlled and cross-contamination-free experiments and to easily upgrade the system to incorporate new capabilities. The system comes with an x-ray microscope-specific seal checking station, which checks the entire system from port flange to tip before inserting the cell into the microscope vacuum chamber.



A. Detector, **B.** Liquid Cell, **C.** Order-Sorting Aperture, **D**. Zone Plate

Features



Don't see what you're looking for? We would also be happy to develop a custom solution for you.

The x-ray liquid holder can be customized for your experimental needs and is compatible with most TEM liquid cell options. Common options include:

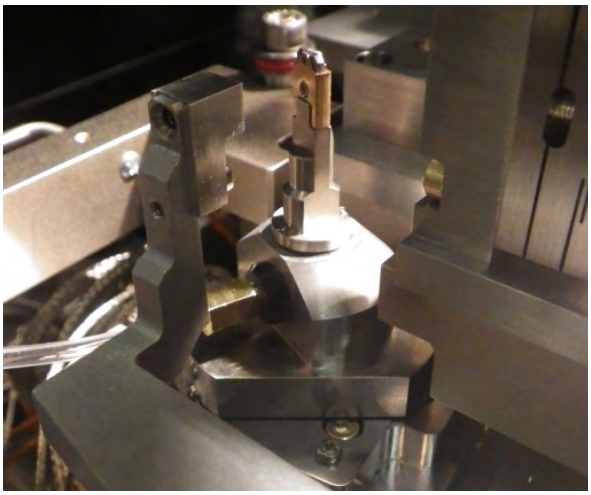
- Continuous Flow
- Dual Flow/Mixing
- Static Cell
- Electrochemistry
- Heating
- Spectroscopy
- Cross-Correlative
- Vapor System

Accessories

Accessories available for your x-ray liquid holder include:

- Specialized liquid-cell chips
- A synchrotron-specific version of our high-vacuum seal-checking station

Product Summary



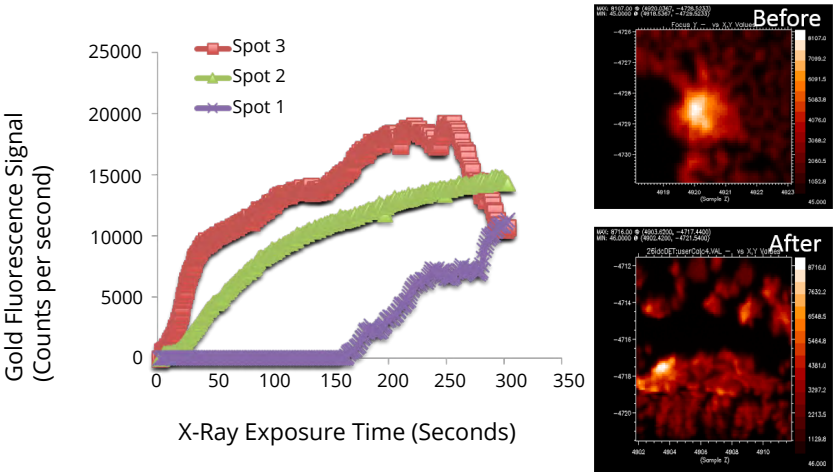
Left: Hummingbird Scientific's liquid-electrochemical x-ray microscope system at the Advanced Photon Source at Argonne National Laboratory.

Specially designed for x-ray microscopes and synchrotron beam line end stations, Hummingbird Scientific's x-ray microscope liquid cell system uses the same removable tip design as our liquid TEM holder, allowing for cross-correlative experiments across x-ray and electron microscope platforms. The two chip fluid cell allows users to quickly and easily prepare and exchange samples while remaining confident in the cell's seal.

Applications:

- Imaging biological specimens in liquid environments
- Liquid-electrochemistry experiments
- Electro catalysis
- Intercalation in battery electrodes
- Electrolysis

Application Example



In-situ x-ray characterization of Au nanoparticle growth

Researchers from Argonne National Laboratory and Hummingbird Scientific have studied gold nanoparticle growth as part of a demonstration of the capabilities of liquid cell imaging in x-ray microscopy. The liquid cell was flushed with Chloroauric Acid and it was exposed to focused scanning probe x-rays with a 100nm spot size in 3 spots for 100 seconds, resulting in the growth of gold particles. The increase in gold fluorescence signal as a function of exposure time suggests that x-ray exposure caused gold nucleation via x-ray induced photo reduction.

Above: X-ray fluorescence plot and images of gold nanoparticle growth inside the environmental cell (left) the growing signal in three different locations signifies particle growth/nucleation. (Right) Images of gold nanoparticles before and after particle growth process. These 2-D maps were taken at two separate points following point scanning. The point scans were taken in the cell using gold chloride. They show the gold nucleating as a result of the beam. **Right:** Argonne National Laboratory, USA

Reference: B. Stripe, V. Rose, M. Misek, S.W. Chee, D.H. Alsem, N. Salmon. "Applications of In-Situ Synchrotron Radiation Techniques in Nanomaterials Research," MRS Spring 2014 Symposium AAA.

Selected Publications

B. Stripe, V. Rose, M. Misek, S.W. Chee, D.H. Alsem, N. Salmon. **"Applications of In-Situ Synchrotron Radiation Techniques in Nanomaterials Research,"** MRS Spring 2014 Symposium AAA

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