

POSEIDON

SELECT

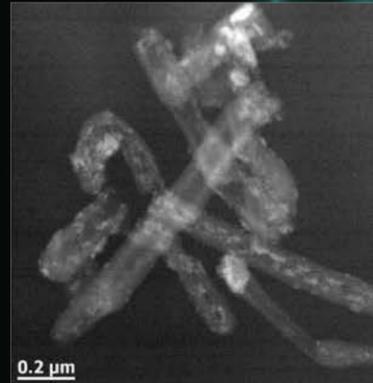
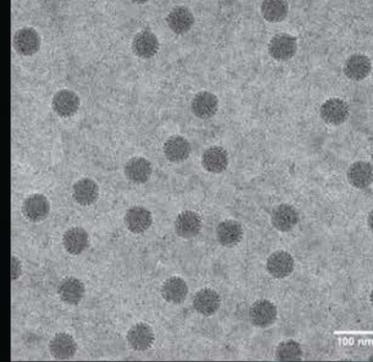
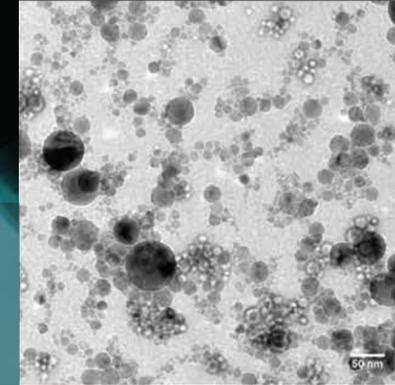
LIQUID ELECTRON MICROSCOPY



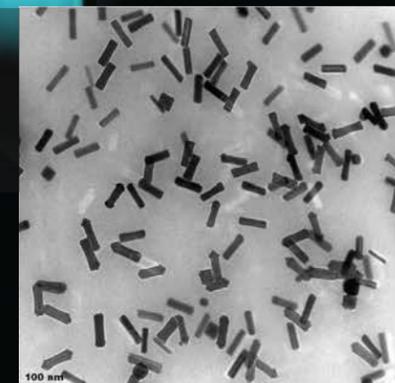
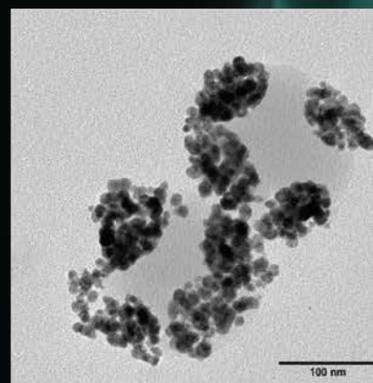
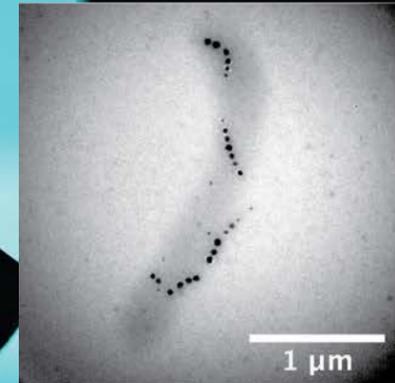
SEE THINGS IN
LIQUID
YOU NEVER THOUGHT
POSSIBLE

Dispersion and Composition
of nanomaterials
in liquid

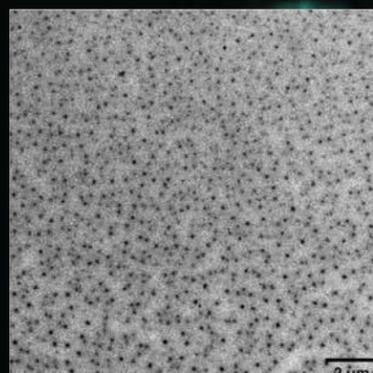
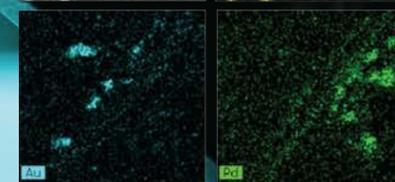
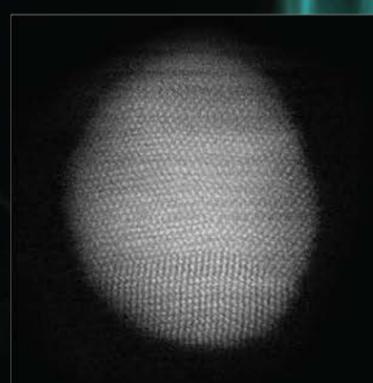
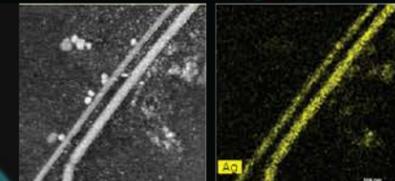
Titanium Dioxide Nanoparticles:
Imaged in water with TEM. (Spacer
thickness: 150 nm; 120 kV TEM)



Pegylated Gold Nanorods:
Imaged in water with energy filtered
TEM. Dr. Joseph Tracy and Ivy
Wu, NC State Univ. (Spacer thick-
ness: 150 nm; 200 kV TEM)



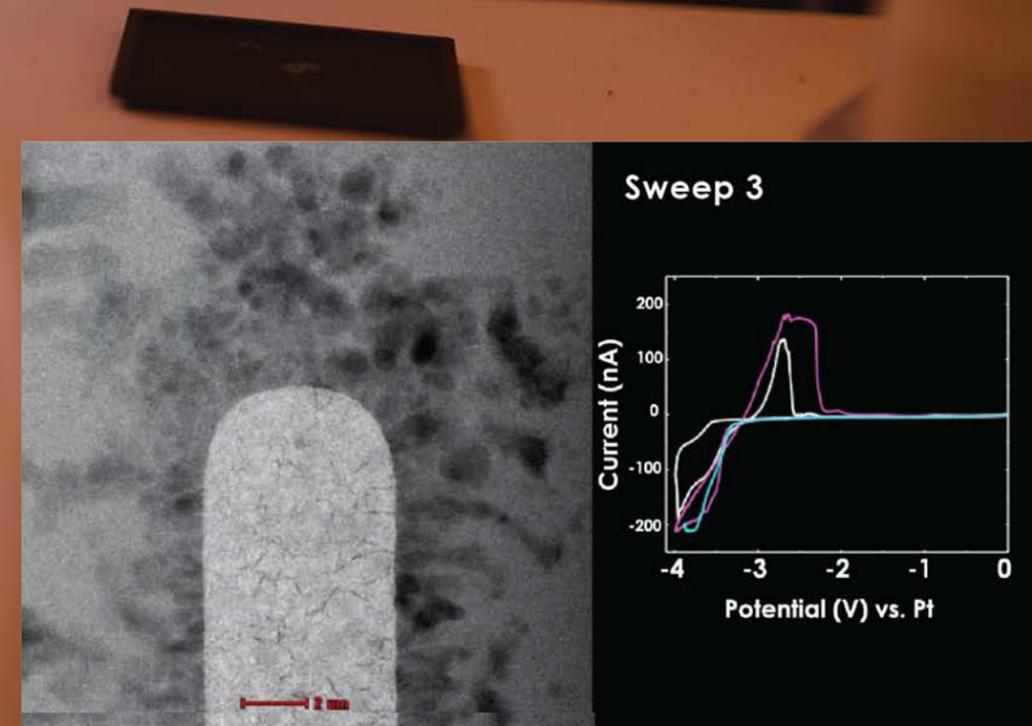
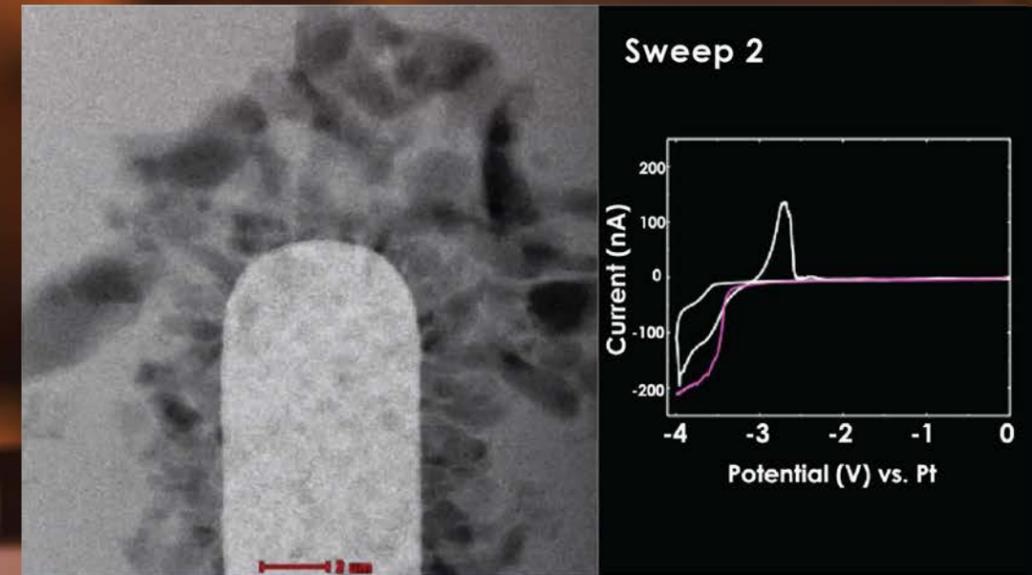
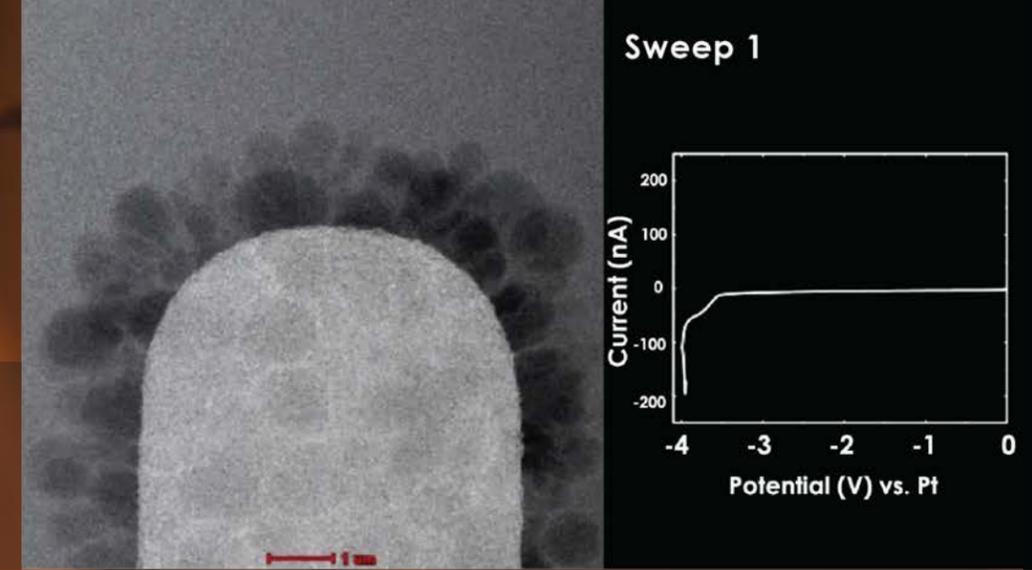
Nanoparticle Soup - Ag, Au, Pd:
E.A. Lewis, S.J. Haigh, M.G. Burke,
N.J. Zaluzec Univ. of Manchester,
Argonne National Lab (Spacer
thickness: 500 nm; 200 kV TEM)

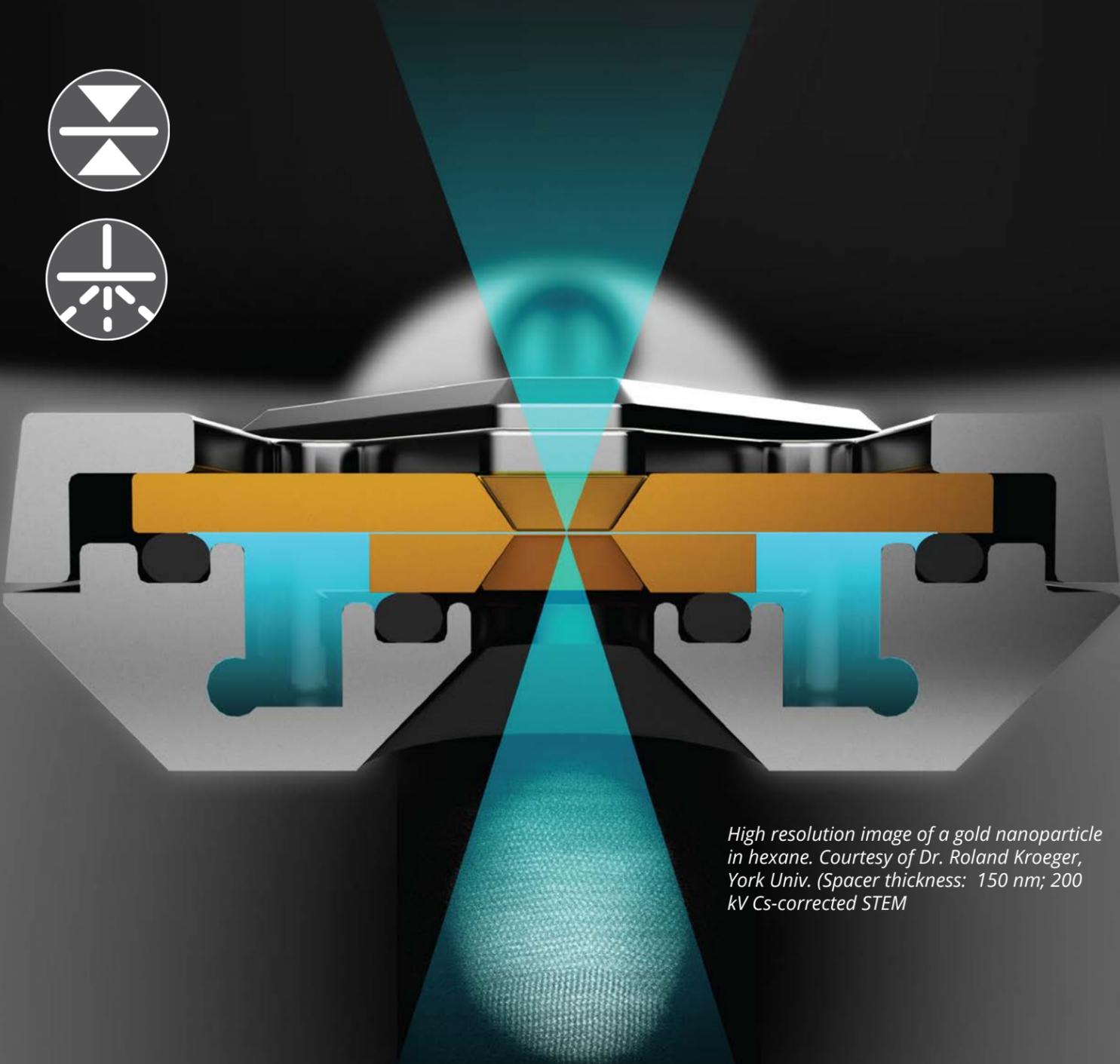
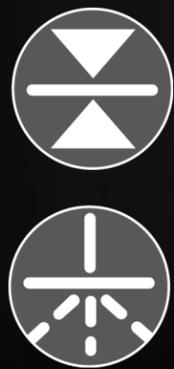


BATTERIES AND ENERGY STORAGE

Image the cycling of lithium batteries while simultaneously taking electrochemical measurements

B. L. Mehdi, N. D. Browning, et al., Nano letters 15.3 (2015): 2168-2173.
E-chip type: Platinum working electrode, 650nm total spacer thickness

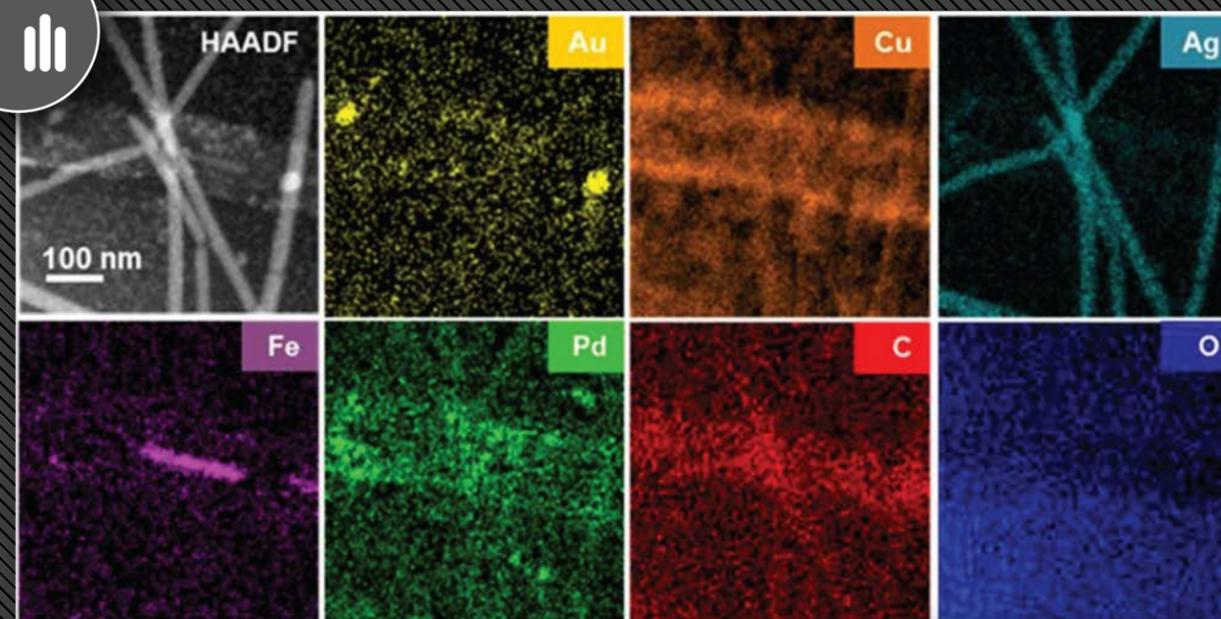




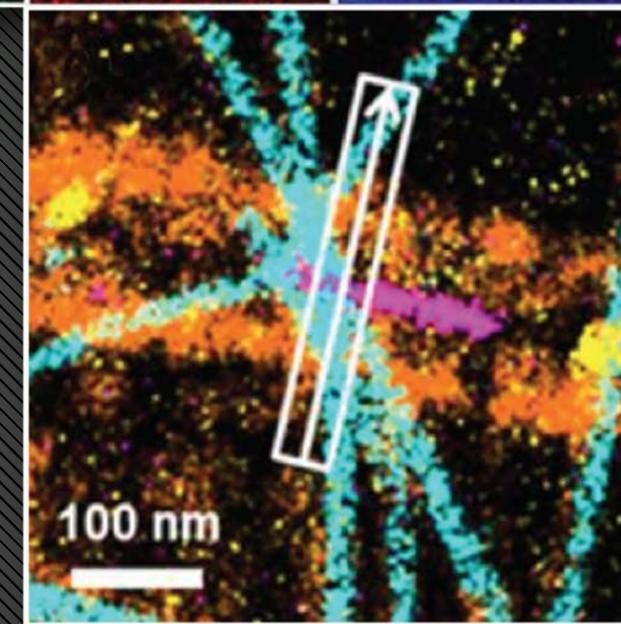
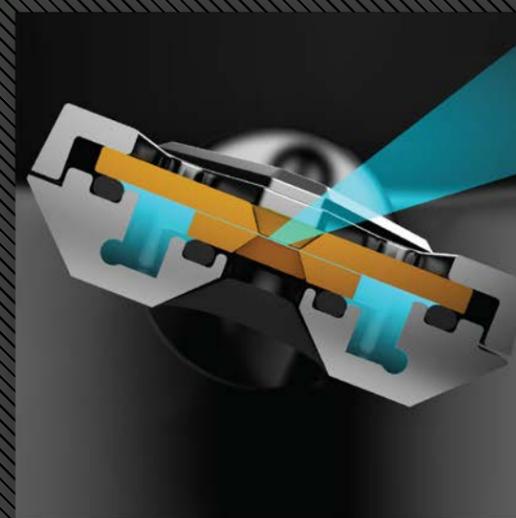
High resolution image of a gold nanoparticle in hexane. Courtesy of Dr. Roland Kroeger, York Univ. (Spacer thickness: 150 nm; 200 kV Cs-corrected STEM)

HIGH QUALITY IMAGING for any sample

Poseidon is based on a wet cell technology, trapping liquid between two ultra-thin, transparent membranes in the microscope. The key to obtaining beautiful images of wet samples is to use the thinnest liquid layer possible for your sample which minimizes scattering. Because samples come in a wide variety of sizes, Protochips has developed a family of consumable E-chips™ that allows the microscopist to select the ideal liquid thickness, from <50nm to 5µm. Our unique Microwell™ design is perfect for the smallest samples where resolution is critical.

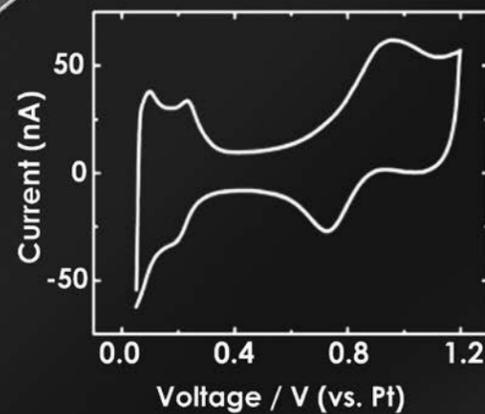
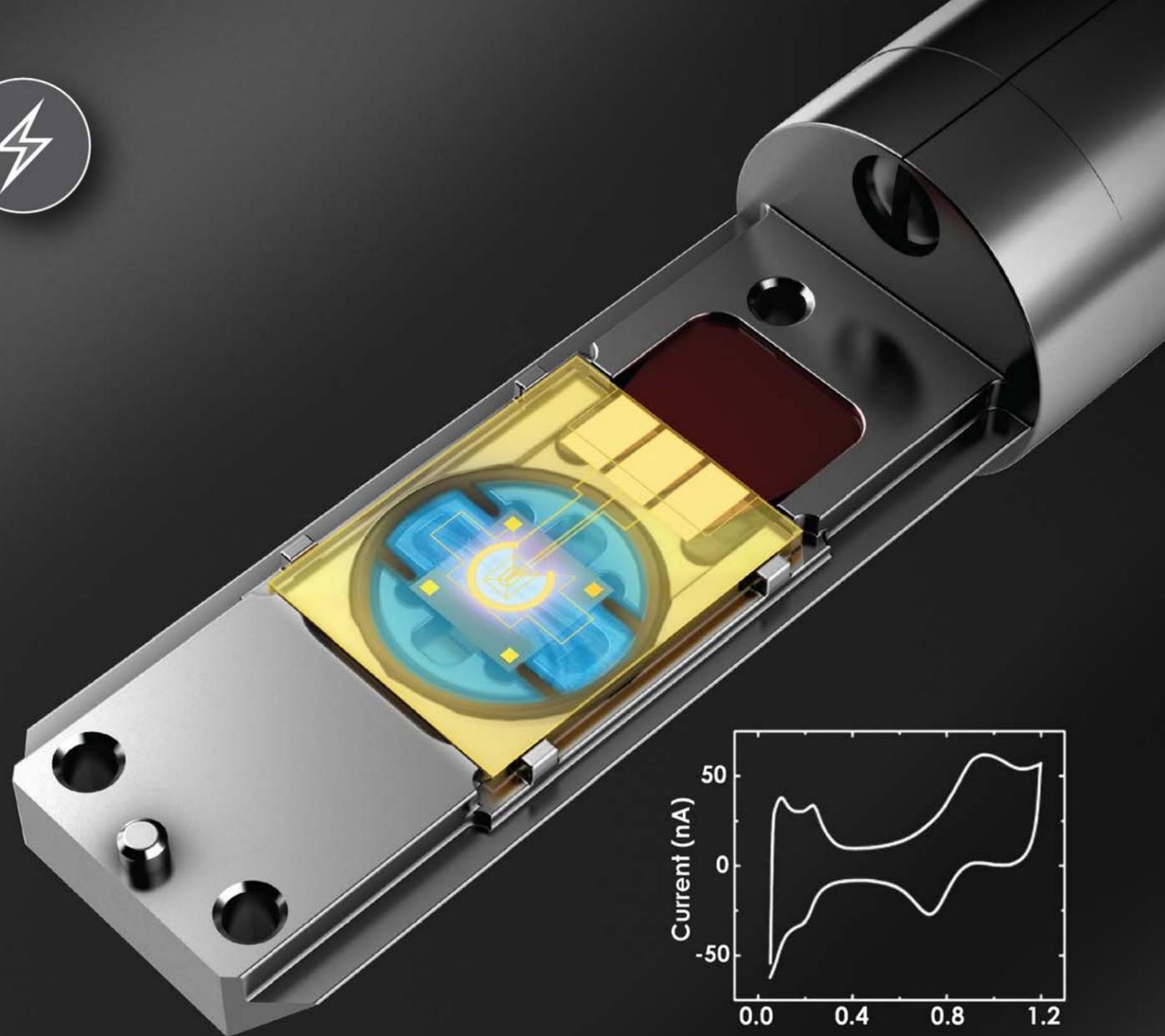


E.A. Lewis et.21. Chem. Commun. 2014, 50, 10019



EDS ELEMENTAL ANALYSIS in liquid

Until now, liquid microscopy has been focused on improving the image quality of wet samples. The unique design of Poseidon now allows, for the first time, true EDS elemental analysis within the TEM. A highly efficient design provides a large line-of-sight angle from the sample to the EDS detector, minimizing tilt and maximizing count rate. Poseidon is even compatible with large, high collection efficiency EDS detectors and multiple detector configurations.



ELECTROCHEMISTRY

The Poseidon Electrochemistry package is available as an option to the Poseidon Select system and adds the capability to perform true in situ quantitative electrochemistry. The Electrochemistry package contains a number of unique design elements that resolve the small currents expected in a miniature cell while maintaining imaging and analytical data collection. Contacts in the TEM holder, and a protective coating on the E-chip, both prevent the electrolyte from reacting with any parts of the cell except the electrodes themselves, ensuring low noise, highly accurate electrical results. Our family of electrochemistry E-chips includes a variety of materials and designs that provide the flexibility needed for many different types of samples.



LIQUID HEATING

The Poseidon Heating package is available as an option to the Poseidon Select system, adding the ability to directly heat liquids within the TEM holder. The temperature is controlled through the Clarity™ software package, which provides closed-loop control to ensure stability and accuracy. The Poseidon Heating Package works in a very unique way to ensure liquid temperature control is accurate, uniform and safe. Rather than using a membrane heater, the Protochips technology heats the entire silicon frame which is in contact with a much larger volume of liquid in the cell. This heats the entire volume of liquid that will flow across the membrane uniformly, without hot or cold spots.

SINGLE GASKET SEALING & LID DESIGN

Patented sealing and lid design enables:

EDS analysis - Material is minimized above the E-chip, providing direct line-of-sight to the sample.

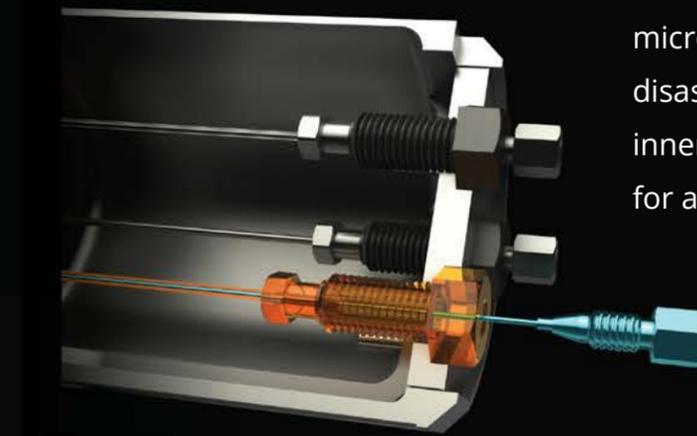
Dry contact - Reactions occur only at the on-chip electrodes making Poseidon truly quantitative.

Safety - With only one gasket, the sealing surface within the tip is minimized, greatly enhancing microscope safety.



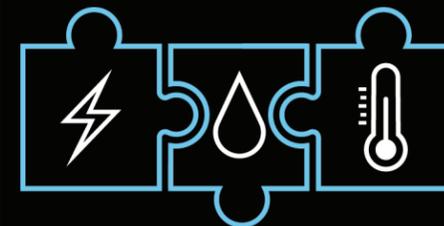
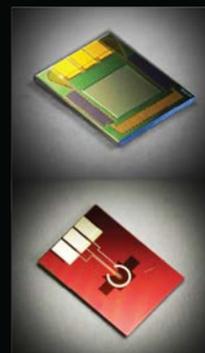
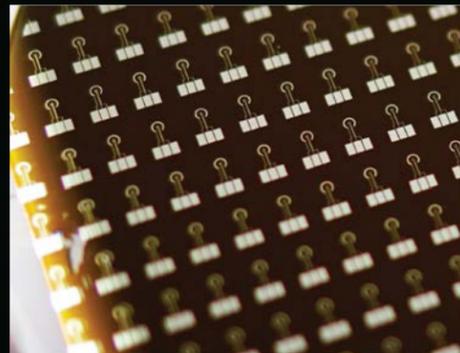
A SAFE METHOD FOR REPLACEABLE TUBING

The Poseidon "tube-in-a-tube" design allows the microscopist to replace the inner tubing without disassembling the TEM holder. By sealing the inner tube against an outer tube, the potential for a leak into the microscope is eliminated.



FAMILY OF E-CHIPS™

Poseidon is based on a family of E-chips, including spacers from <math><50\text{nm}</math> to



CONFIGURABLE AND EXPANDABLE

Poseidon Select starts with a base system that includes the TEM holder. Heating and Electrochemistry packages can each be added depending on the area of interest. One or both of these packages can be added either immediately or in the future as needed, making the Poseidon Select system configurable and expandable.



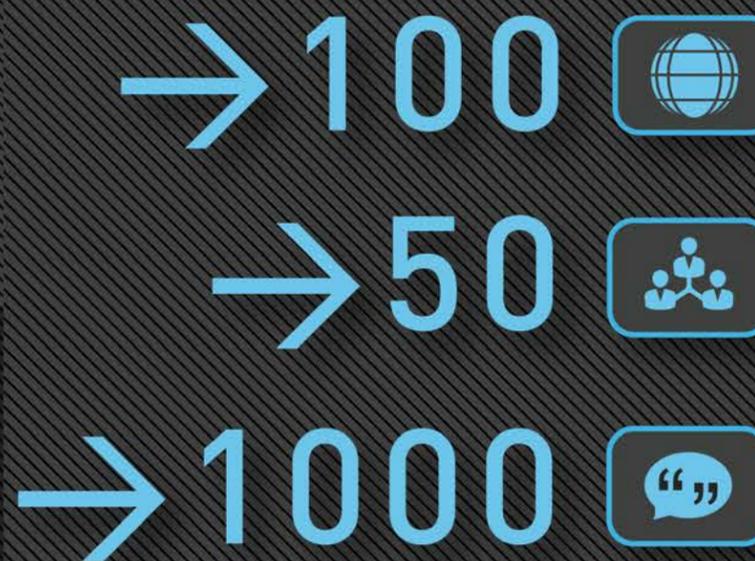
"The Poseidon system changes the way we envision biology. It is now possible to study live entities at the nanoscale – truly seeing the world through a new lens."

- Dr. Deborah Kelly, Virginia Tech, USA



"Poseidon opens up a new frontier in my field of crystallization and also provides the wonderful opportunity to create new relationships and collaborations in scientific fields I've never touched before."

- Dr. Yuki Kimura, Hokkaido University, Japan



Over 100 Poseidon holders in the market

Over 50 scientific peer-reviewed journal articles

Over 1000 citations

"The development of innovative nanomaterials requires establishing the links between their atomic-scale structure and their properties ... the Poseidon system is a cutting edge approach because it provides unprecedented mechanistic insights into the formation of nanomaterials through chemical paths and into the transformation undergone by nanostructures in biological media."

- Dr. Damien Alloyeau, University of Paris, France



ONE HOLDER, ENDLESS POSSIBILITIES



EX SITU CELL

Analyzing electrochemical results within the TEM can be complicated without a point of comparison. Protochips offers an ex situ cell which functions identically to the Poseidon Select holder. An entire electrochemistry experiment, including liquid flow, can be run outside of the microscope and later compared to results acquired with the TEM for comparison, isolating any effects attributed to the microscope.

Sample preparation is also made easier through this platform for developing sample deposition methods outside of the microscope.



POSEIDON SELECT SPECIFICATIONS

Flow Ports	3 (static, flow or mixing)
Number of Electrodes	3 (WE, CE, RE)
Replaceable Tubing	YES
Analytical Compatibility	EDS, EELS
Resolution	2 ±1 nm or better
Configurable E-chip Spacer	microwells, 0 nm, 50 nm, 150 nm, 500 nm, 1 µm or 5 µm
E-chip Sealing Method	1 gasket
Heating	RT to 100°C closed-loop control



Protochips

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