

# X-ray ptychography, fluorescence microscopy combo sheds new light on trace elements

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Scientists have developed a new approach that combines ptychographic X-ray imaging and fluorescence microscopy to study the important role trace elements play in biological functions on hydrated cells.

A team of researchers using the Advanced Photon Source, a U.S. Department of Energy Office of Science User Facility at Argonne National Laboratory, demonstrated unparalleled sensitivity for measuring the distribution of trace elements in thicker specimens at [cryogenic temperatures](#), in this case at about 260 degrees below Fahrenheit.

Trace metals are important in normal and disease-causing [biological functions](#). Until now, researchers believe, it was impossible to obtain images of biological samples with such high combined structural and chemical fidelity.

"X-ray fluorescence lets us see trace metals in cells with fantastic sensitivity, and ptychography lets us correlate that with cellular ultrastructure," said Junjing Deng, an applied physics graduate student at Northwestern University. Ptychography is an approach to obtain absorption and phase contrast images from scattered light with no lens-imposed resolution limit, making use of the overlap between multiple coherent illumination spots.

Scientists studied a frozen-hydrated green algae specimen. Frozen hydrated samples under cryogenic conditions are better able to withstand

beam-induced degradation and can provide high-fidelity structural and ionic elemental preservation.

"This advance required the high brightness of the APS as an X-ray source and points the way to advances that can be expected as it is planned to be increased a hundredfold in the future," said Chris Jacobsen, an associate division director in the X-ray Sciences Division at Argonne and a professor at Northwestern University.

Research was conducted at the APS' Bionanoprobe, a hard X-ray nanoprobe with cryogenic sample transfer capabilities at beamline 21-ID-D.

**More information:** "Simultaneous cryo X-ray ptychographic and fluorescence microscopy of green algae." *PNAS* 2015 112 (8) 2314-2319; published ahead of print February 9, 2015, [DOI: 10.1073/pnas.1413003112](https://doi.org/10.1073/pnas.1413003112)

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