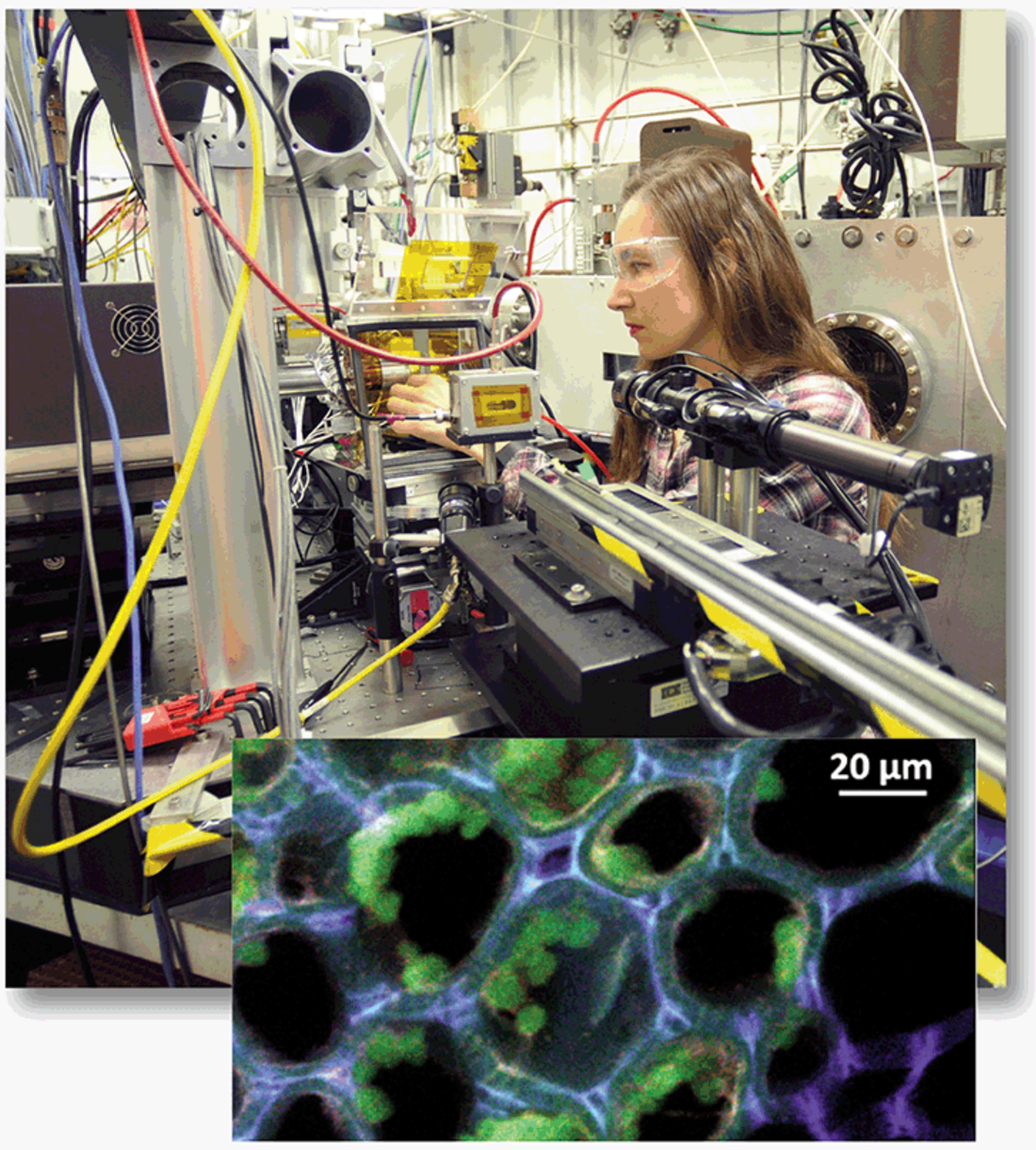
The Advanced Photon Source

The X-ray Fluorescence Microprobe at APS Beamline 2-ID-E

The x-ray fluorescence microprobe is an excellent tool for studying elemental distribution in many-micrometer-thick specimens with sub-micron spatial resolution, part-per-million detection sensitivity, and the ability to acquire tomographic datasets with minimal sample modifications [1].

The Advanced Photon Source (APS) microprobe at the X-ray Science Division 2-ID-E beamline is optimized for biological samples with low concentrations of transition elements. Samples (biological tissue sections, cells, crystals, etc.) are raster-scanned with a Fresnel zone plate-focused x-ray beam (typically 10 keV) and the x-ray fluorescence signal is recorded by a Vortex SDD detector for each pixel with 200-nm to 500-nm resolution. In addition, x-ray absorption and phase-contrast data are recorded. A helium-filled sample chamber helps increase sensitivity to low Z elements such as phosphorus, chlorine, calcium, and potassium. MAPS software is used for building elemental maps and for quantifying elemental concentrations in each pixel and in regions of interest.

This information in complex with other biochemical methods helps in understanding a variety of biological processes, such as embryo development, cancer spreading mechanisms, and cellular response to treatments, as well as migration of metals through tissues, such as those used in MRI contrast agents [2].



Olga Antipova, assistant physicist at the APS places a sample in x-ray fluorescent microprobe at the APS 2-ID-E beamline. This instrument is used for imaging and quantification of various elements in biological and other samples, critical for understanding of numerous normal and pathological processes. Inset: Distribution of phosphorus (red), calcium (blue) and elevated levels of potassium (green) within 10-µm thin section of Manchurian ash wood, which is resistant to the emerald ash wood borer.

References

[1] T. Paunesku, S. Vogt, J. Maser, B. Lai, G. Woloschak. X-ray fluorescence microprobe imaging in biology and medicine.J Cell Biochem. **99**(6), 1489-1502 (2006).

[2] D. Mustafi, J. Ward, U. Dougherty, M. Bissonnette, J. Hart, S. Vogt, G.S. Karczmar. X-ray fluorescence microscopy demonstrates preferential accumulation of a vanadium-based magnetic resonance imaging contrast agent in murine colonic tumors. Mol Imaging. **14**, 1535-1-1535-12 (2015).

Beamline correspondence: Olga Antipova, oantipova@anl.gov

Call for APS General-User Proposals

The Advanced Photon Source is open to experimenters who can benefit from the facility's high-brightness hard x-ray beams.

General-user proposals for beam time during Run 2017-3 are due by Friday, July 7, 2017.

Information on access to beam time at the APS is at http://www.aps.anl.gov/Users/apply_for_beamtime.html or contact Dr. Dennis Mills, DMM@aps.anl.gov, 630/252-5680.

Argonne National Laboratory is a U.S. Department of Energy (DOE) laboratory managed by UChicago Argonne, LLC

The Advanced Photon Source is a U.S. DOE Office of Science User Facility operated for the DOE Office of Science by Argonne National Laboratory under Contract No. DE-AC02-06CH11357

Follow us: @advancedphoton **Like us:** Advanced Photon Source **flickr:** advancedphotonsource12

Argonne NATIONAL LABORATORY

www.anl.gov

Advanced Photon Source
Bldg. 401/Rm A4115
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439 USA
www.aps.anl.gov
apsinfo@aps.anl.gov

U.S. DEPARTMENT OF ENERGY
Office of Science