

Fast 3D nano-imaging of materials with the new TXM of APS

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Over the past decade, technology breakthroughs in the field of x-ray optics have enabled the development of advanced imaging nanoprobe like the in-house built Transmission X-ray Microscope (TXM) operating at beamline 32-ID of the Advanced Photon Source (APS) [1] and optimized for *in-situ* nanotomography experiments. This instrument has been supporting user experiments for more than three years over broad scientific fields including environmental sciences (Fig. 1). The TXM provides a spatial resolution ranging from 60 nm down to, the recently achieved, 16 nm for respective fields of view of $\sim 70\ \mu\text{m}$ and $15\ \mu\text{m}$.

Together with hardware improvements, we endeavor to overcome certain physical limitations by developing advanced scientific software methods. An example of a recent study, shows how algorithms enabled the first 3D dynamic study at the nanoscale with a time resolution in the order of one minute. Several additional TXM applications will be presented featuring environmental science applications and imaging tools that might benefit the whole community.

We will conclude this presentation with an overview of the ongoing development of a point projection microscope that will complement the TXM by the end of 2018.

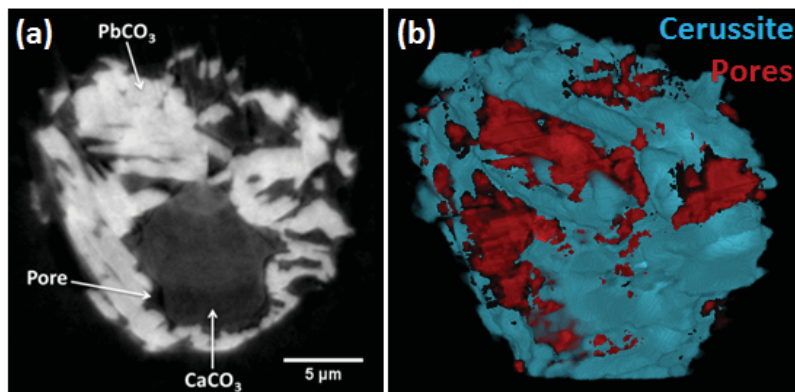


Figure 1: (a) 3D reconstruction of a calcite mineral partially replaced by cerussite after immersion in a lead rich solution. (b) Segmentation of calcite, cerussite and induced porosity (Yuan et al. [2]).

References

- [1] Vincent De Andrade, Alex Deriy, Michael Wojcik, Doga Gürsoy, Deming Shu, Kamel Fezzaa and Francesco De Carlo, “A new Transmission X-ray Microscope for nano-scale 3D imaging at the Advanced Photon Source”. SPIE Newsroom, 2016. DOI: 10.1117/2.1201604.006461.
- [2] Yuan, K., Lee, S. S., De Andrade, V., Sturchio, N. C., & Fenter, P. “Replacement of Calcite (CaCO₃) by Cerussite (PbCO₃).” *Environmental Science & Technology*, 2016, 50(23), 12984-12991.