



# Vincent De Andrade

Physicist, beamline scientist

PhD in Earth Sciences

## Professional Experience

### 2014-2019:

- Beamline scientist (physicist) in charge of the in-house Transmission X-ray Microscope (TXM), an instrument for full-field nano-tomography at sector 32-ID at APS, Argonne National Laboratory.  
Secondary projects:
  - From 2018: member of the development team of ISN, the *In Situ* hard X-ray Nanoprobe, one of the project beamlines selected for the multi-bend achromatic (MBA) lattice upgrade at APS.
  - In 2017: technical lead at APS of a project involving ptycho-tomography, in the framework of an IARPA program for imaging entire modern silicon integrated circuit chips with 10 nm 3D spatial resolution.

**2010-2014:** beamline scientist at the National Synchrotron Light Source II on the Sub-micron Resolution X-ray spectroscopy (SRX) beamline, Brookhaven National Laboratory.

- Conception of the SRX beamline from the optical components to the end-station design
- Supervision of Master students.

**2007-2009:** Postdoctoral position at the European Synchrotron Radiation Facility, on the ID21 spectromicroscopy beamline.

- Development of a full-field setup optimized for micro-spectroscopy (hyperspectral imaging).
- Regular local contacts on experiments covering many fields of Science.

**2004-2006:** 110 hours of teaching in the Earth Sciences department of Joseph Fourier Univ., Grenoble.

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## Education

**2002-2006:** PhD thesis in Earth Sciences at the ISTerre CNRS institute at the Joseph Fourier Univ., France (in partnership with the CEA Cadarache).

**1997-2002:** License + Master. Earth Sciences (geochemistry & geophysics).  
Claude Bernard University, Lyon I & Joseph Fourier University, Grenoble I

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## Scientific interest

### Instrumentation

- Design, integration and operation of a nano-tomography instrument (TXM)
- Design of X-ray fluorescence microscope (micro and nanoprobe).
- Full-field  $\mu$ -spectroscopy setup development (Analytical Chemistry 2011)
- Beamline performance modelling: impact of optic quality on beamline performances (SPIE 2011)

## Earth Sciences

Deciphering information recorded in rocks bearing minerals to retrace the Pressure-Temperature history of single rocks from which are derived geodynamic models. It involves the conjoint use of novel thermodynamic approaches with elemental and redox images.

## Applied Sciences

Nano & micro-tomography studies of a multitude of materials

## Software development for imaging

Machine learning for volume segmentation, low-dose tomography, super-resolution...

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## Analytical techniques

**Full-field nano-tomography:** conception and operation of a TXM for 3D nano-imaging. Implementation of new optic for Zernike-type phase contrast.

Integration of a  $\mu$ -CT system at 32-ID (APS), experiment led at the ESRF, NSLS I, APS.

**$\mu$ -XANES spectroscopy:** development of a Hard X-rays full-field setup optimized for high quality spectroscopy studies. Submicrometer resolution XANES cartographies are obtained on rocks or biological thin sections (ID21). Polarization Contrast Imaging has been implemented to the setup.

- Spectroscopy performed with sub-micro beam focused with KB mirrors or Zone plates

**$\mu$ -X-ray Fluorescence:** X-ray fluorescence imaging, analysis quantification with the PyMCA software.

**Infrared spectroscopy:** Experiments on ID21 (ESRF) on clays & phyllosilicates.

**Electron Probe Micro Analyzer:** X-ray fluorescence elemental imaging: optimization of an analytical methodology based on elemental images.

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## Beamline Design

- Design of a Transmission X-ray Microscope at APS, sector 32-ID

- Beamline layouts optimization

- Ray tracing using Shadow software: macros to optimize beamline layout performances scanning various parameters

- Investigation of heat load on optics

Combined use of FEA, SRW and Shadow VUI to model the heat load impact on the beamline performances.

- Conception of a Microprobe and Nanoprobe end-station at NSLS-II. In the framework, visit of multiple synchrotron facilities (NSLS I, APS, Petra III, ESRF, Soleil).

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## Computing skills

### Matlab & Python programming

- beamline control scripts in python

- Tomopy expert user

- function minimization

- Statistic tools (PCA, Monte Carlo), image treatment (filtering, automatic alignment, visualization...)

- Development of a set of tools for the treatment of hyperspectral images (automatic normalization and pre-edge fitting)

- GUI development: software for the ID21's users fitting XANES spectra by linear combination of end-member (least square method).

- Scripts for Electronic Probe Micro Analyzer (EPMA) images quantification

- Thermodynamic functions / tools for mineralogical reactions

# Publications

## YEAR 2019

- [71] Shu, Deming, Vincent De Andrade, Jayson Anton, Steven Kearney, Kamel Fezzaa, Sunil Bean, Alex Deriy et al. "Mechanical design of a flexural nanopositioning stage system for hard x-ray nanofocusing at the Advanced Photon Source 32-ID-C station." In ***X-Ray Nanoimaging: Instruments and Methods IV***, vol. 11112, p. 111120N. International Society for Optics and Photonics, 2019.
- [70] Kaira, C. Shashank, Tyler Stannard, Vincent De Andrade, Francesco De Carlo, and Nikhilesh Chawla. "Exploring Novel Deformation Mechanisms in Aluminum-Copper alloys using in situ 4D Nanomechanical testing." ***Acta Materialia*** (2019).
- [69] Zaman, Wahid, Nicholas M. Hortance, Marm B. Dixit, Vincent De Andrade, and Kelsey Bridget Hatzell. "Visualizing percolation and ion transport in hybrid solid electrolytes for Li-metal batteries." ***Journal of Materials Chemistry A*** (2019).
- [68] Wu, Linmin, Vincent De Andrade, Xianghui Xiao, and Jing Zhang. "Phase Field Modeling of Coupled Phase Separation and Diffusion-Induced Stress in Lithium Iron Phosphate Particles Reconstructed From Synchrotron Nano X-ray Tomography." ***Journal of Electrochemical Energy Conversion and Storage*** 16, no. 4 (2019): 041006.
- [67] Steven P. Kearney\*, Deming Shu, Vincent De Andrade, and Jörg Maser. "Optomechanical Design of a Portable Metrology System for Measurement of Precision Rotary Stage Errors", ***SPIE conference*** 2019, *in press*.
- [66] D. Shu, V. De Andrade, J. Anton, S. Kearney, K. Fezzaa, S. Bean, A. Deriy, W. Liu, J. Maser, B. Lai, J. Z. Tischler, and F. De Carlo. "Mechanical design of a flexural nanopositioning stage system for hard x-ray nanofocusing at the Advanced Photon Source 32-ID-C station", ***SPIE conference*** 2019, *in press*.
- [65] Maser, Jorg, Barry Lai, Vincent De Andrade, Simon R. Bare, Mariana Bertoni, Tonio Buonassisi, Paul Evans et al. "Design Concept for the In Situ Nanoprobe Beamline for the APS Upgrade." ***Microscopy and Microanalysis*** 24, no. S2 (2018): 194-195.
- [64] Yuan, Ke, Vitalii Starchenko, Sang Soo Lee, Vincent De Andrade, Doga Gursoy, Neil C. Sturchio, and Paul Fenter. "Mapping three-dimensional dissolution rates of calcite microcrystals: Effects of surface curvature and dissolved metal ions." ***ACS Earth and Space Chemistry*** (2019).
- [63] Mizutani, Ryuta, Rino Saiga, Akihisa Takeuchi, Kentaro Uesugi, Yasuko Terada, Yoshio Suzuki, Vincent De Andrade et al. "Three-dimensional alteration of neurites in schizophrenia." ***Translational psychiatry*** 9, no. 1 (2019): 85.

## YEAR 2018

- [62] S. Müller, P. Pietsch, B. E. Brandt, P. Baade, V. De Andrade, F. De Carlo & V. Wood. "Quantification and modeling of mechanical degradation in lithium-ion batteries based on nanoscale imaging." ***Nature Communication***, volume 9, Article number: 2340 (2018).
- [61] Normile, S.J., Sabarirajan, D.C., Calzada, O., De Andrade, V., Xiao, X., Mandal, P., Parkinson, D.Y., Serov, A., Atanassov, P. and Zenyuk, I.V. "Direct observations of liquid water formation at nano- and micro-scale in platinum group metal-free electrodes by operando X-ray computed tomography." ***Materials Today Energy***, 9, (2018), pp.187-197.
- [60] C. S. Kaira, X. Yang, V. De Andrade, F. De Carlo, W. Scullin, D. Gursoy, N. Chawla. "Automated correlative segmentation of large Transmission X-ray Microscopy (TXM) tomograms using deep learning." ***Materials Characterization***, 142, (2018) 203–210.
- [59] Li, T., H. Kang, X. Zhou, C. Lim, B. Yan, V. De Andrade, F. De Carlo, and L. Zhu. "Three-Dimensional Reconstruction and Analysis of All-Solid Li Ion Battery Electrode Using Synchrotron Transmission X-ray Microscopy Tomography." ***ACS applied materials & interfaces***, 2018.
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- [51] Moldovan N, Divan R, Zeng H, Ocola LE, De Andrade V, Wojcik M. "Atomic layer deposition frequency-multiplied Fresnel zone plates for hard x-rays focusing." *Journal of Vacuum Science & Technology A: Vacuum, Surfaces, and Films*, Jan;36(1):01A124, 2018.

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- [50] C. S. Kaira, V. De Andrade, S. S. Singh, C. Kantzos, A. Kirubanandham, F. De Carlo and N. Chawla. "Probing Novel Microstructural Evolution Mechanisms in Aluminum Alloys using Four-dimensional Nanoscale Characterization". *Advanced Materials*, DOI: 10.1002/adma.201703482, 2017.
- [49] J. Yi, Y. Wang, Y. Jiang, I. W. Jung, W. Liu, V. De Andrade, R. Xu, R. Parameswaran, I. Peters, R. Divan, X. Xiao, T. Sun, Y. Lee, W. I. Park, and B. Tian. "3D calcite heterostructures for dynamic and deformable mineralized matrices". *Nature Communication*, 2017.
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- [47] E. Eustache, C. Douard, A. Demortière, V. De Andrade, M. Brachet, J. Le Bideau, T. Brousse, C. Lethien. "High Areal Energy 3D Interdigitated Micro Supercapacitors in Aqueous and Ionic Liquid Electrolytes." *Advanced Materials Technologies*, 2017.
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- [44] H. Lisabeth, W. Zhu, T. Xing and V. De Andrade. "Dissolution assisted pattern formation during olivine carbonation." *Geophysical Research Letters*, 2017.
- [43] A. Serov, A. D. Shum, X. Xiao, V. De Andrade, K. Artyushkova, I. V. Zenyuk and Plamen Atanassov. "Nano-structured platinum group metal-free catalysts and their integration in fuel cell electrode architectures." *Applied Catalysis B: Environmental*, 2017, doi.org/10.1016/j.apcatb.2017.08.067.
- [42] A. G. Kashkooli, E. Foreman, S. Farhad, D. U. Lee, K. Feng, G. Lui, V. De Andrade and Z. Chen. "Morphological and electrochemical characterization of a nanostructure Li<sub>4</sub>Ti<sub>5</sub>O<sub>12</sub> electrode using multiple imaging mode synchrotron X-ray computed tomography." *Journal of The Electrochemical Society*, in press.
- [41] A. G. Kashkooli, E. Foreman, S. Farhad, D. U. Lee, W. Ahn, K. Feng, V. De Andrade, Z. Chen. (2017). "Synchrotron X-ray nano computed tomography based simulation of stress evolution in LiMn<sub>2</sub>O<sub>4</sub> electrodes." *Electrochimica Acta*, 247, 1103-1116.
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- [37] H. Kang, C. Lim, T. Li, Y. Fu, B. Yan, N. Houston, V. De Andrade, F. De Carlo and L. Zhu "Geometric and Electrochemical Characteristics of LiNi<sub>1/3</sub>Mn<sub>1/3</sub>Co<sub>1/3</sub>O<sub>2</sub> Electrode with Different Calendering Conditions." *Electrochimica Acta*, 232 (2017): 431-438.
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- [33] J. Ganne, W. P. Schellart, G. Rosenbaum, X. Feng, **V. De Andrade**, "Probing crustal thickness evolution and geodynamic processes in the past from magma records: An integrated approach." *Geological Society of America Special Papers*. 2017 Jan 27; 526:SPE526-01.

## YEAR 2016

- [32] Y. Jiang, J. L. Carvalho-de-Souza, R. C. S. Wong, Z. Luo, D. Isheim, X. Zuo, A. W. Nicholls, Il W. Jung, J. Yue, D.J. Liu, Y. Wang, V. De Andrade, X. Xiao, L. Navrazhnykh, D. E. Weiss, X. Wu, D. N. Seidman, F. Bezanilla, B. Tian, "Heterogeneous silicon mesostructures for lipid-supported bioelectric interfaces", *Nature Materials* (2016) doi:10.1038/nmat4673.
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- [26] C. Lim; B. Yan; H. Kang; Z. Song; W. C. Lee; V. De Andrade; F. De Carlo; L. Yin; Y. Kim; L. Zhu, "Analysis of Geometric and Electrochemical Characteristics of Lithium Cobalt Oxide Electrode with Different Packing Densities." *Journal of Power Sources*, 328, pp.46-55 (2016).
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## YEARS 2006 to 2014

- [20] **V. De Andrade**, J. Ganne, B. Dubacq, C. G. Ryan, F. Bourdelle, A. Plunder, G. Falkenberg, J Thieme, "Retrieving past geodynamic events by unlocking rock archives with  $\mu$ -XRF and  $\mu$ -spectroscopy", *J. Phys.: Conf. Ser.* 499 012012, (2014).
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- [16] **V. De Andrade**, Susini, J., Salomé, M., Beraldin, O., Rigault, C., Heymes, T., Lewin, E., and Vidal, O., "Imaging of heterogeneous rocks and materials by full-field X-ray micro-spectroscopy," *ESRF Highlights* (2012).



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## Communications

- V. De Andrade, A. Deriy, M. Wojcik, D. Gürsoy, D. Shu, S. Bean, X. Yang, D. Pelt, S. Kaira, N. Chawla, F. De Carlo. "Recent contributions of X-ray nano-tomography to Materials Science." Kick-off Workshop Center for 4D Materials Science (4DMS), ASU, 2017, *invited talk*.
- V. De Andrade. "Workshop on Fundamental Limits to Measurements in Neurobiology." Janelia Research Center, Virginia, 2017. *Informal presentation, invited*.
- V. De Andrade. "Advancing Neuroscience with the National Labs." Grossman Institute, University of Chicago, 2017. *Informal discussion, presentation of 32-ID to the workshop attendees, invited*.
- C. Shashank Kaira, Tyler Stannard, Vincent De Andrade, Francesco De Carlo, Nikhilesh Chawla. "Nanoscale Deformation Behavior in Aluminum alloys using Micromechanical Testing and Transmission X-Ray Microscopy (TXM)." 2018 TMS Annual Meeting & Exhibition.

- Sampathkumar V., De Andrade V., Li H., Du M., Vescovi R, Leone V., Chang E.B., Kasthuri N, “The influence of the gut microbiome on the ‘connectome’ of the enteric nervous system.” Microbiome Center Research Symposium by The Microbiome Center ( UChicago -- MBL – Argonne), 2017.
  - S. Kaira, V. De Andrade, N. Chalwa, “Probing 4D Microstructural Evolution in Aluminum alloys using Transmission X-Ray Microscopy (TXM)”, ICTMS 2017.
  - N. Moldovan, R. Divan, H. Zeng, L. E. Ocola, V. DeAndrade, M. Wojcik. “ALD-frequency multiplied Fresnel zone plates for hard X-rays focusing.” ALD 2017 Conference in Denver, CO, *poster*.
  - Doga Gürsoy, Tekin Biçer, Daniel Ching, Vincent De Andrade, “Sliding ordered-subset algorithm for real-time x-ray tomography”, Developments in X-Ray Tomography XI, SPIE 2017.
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