

# Boris Kramar, PhD

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## CAREER SUMMARY

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Researcher specialising in characterisation of materials using X-ray methods, particularly X-ray absorption spectroscopy and small-angle X-ray scattering. In graduate school, studied light-induced processes in zirconium-based metal—organic frameworks, focusing on charge transfer processes. As a postdoc, honed expertise in X-ray methods through in-depth investigative work on structural properties of disordered actinide oxides and salts. Current research interests include X-ray methods, environmental chemistry, Bayesian inference, data analysis and modelling. Full work rights in Australia.

## EDUCATION

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**Ph.D.**, Inorganic & Physical Chemistry Northwestern University, Evanston, IL, USA **2018 – 2023**

*Dissertation title: The Relationship between Node Ligand Environment and Excited State Dynamics of Zirconium-Based Metal—Organic Frameworks.*

*Advisors: Prof. Joseph T. Hupp, Prof. Lin X. Chen*

**B.S.**, Chemistry Rensselaer Polytechnic Institute, Troy, NY, USA **2014 – 2018**

## RESEARCH EXPERIENCE

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**Postdoctoral Scholar** at Moscow State University, Moscow, Russia **Mar. 2024 – Dec. 2025**

**Summary:** Carried out fundamental research within the Radiochemistry Division, Department of Chemistry, headed by Professor Stepan N. Kalmykov. Hybrid role. Research focus: structure of solid actinide compounds. Outputs: 2 publications (+1 in preparation), 2 conference talks.

### Key Achievements:

- Characterised morphology in a series of amorphous thorium oxides by applying a combination of small-angle X-ray scattering, X-ray diffraction, X-ray pair distribution function, transmission electron microscopy and mass fractal aggregate growth simulations
- Described speciation of thorium in an environment mimicking agricultural runoff: isolated hydrated sodium-thorium phosphates, characterised their structure and chemical composition by applying electron microscopy and X-ray absorption spectroscopy (DOI: [10.1039/D5DT00276A](https://doi.org/10.1039/D5DT00276A))
- Applied extended X-ray absorption fine structure spectroscopy, including Reverse Monte-Carlo analysis, to confirm local structure around neptunium and plutonium cations in phosphates and carbonates forming under conditions mimicking a nuclear waste storage breakthrough scenario (DOI: [10.1039/D5DT00913H](https://doi.org/10.1039/D5DT00913H)).
- Developed a synthetic protocol to synthesise known hydrated cerium phosphates (proxies for plutonium phosphates) with deuterons instead of protons to facilitate a neutron diffraction structural study
- Prepared and completed 3 successful experimental proposals for SAXS and neutron diffraction experiments at large-scale user facilities within the Kurchatov Institute National Research Centre (Moscow, Russia) and the Joint Institute for Nuclear Research (Dubna, Russia)

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**Graduate Research Assistant** at Northwestern University, Evanston, IL, USA **Sep. 2018 – Dec. 2023**

**Summary:** Carried out fundamental research within the Hupp & Chen Research Groups, Department of Chemistry. Research focus: photophysics of Zr-based metal—organic frameworks. Managed laboratory instrumentation. Outputs: 8 publications (+1 submitted), 1 conference talk.

### Key Achievements:

- Modelled excited state evolution as a function of acidity of the aqueous environment for a zirconium-based metal—organic framework by applying target kinetic analysis; based on the results, suggested a hole transfer based mechanism for the formation of the excited state (DOI: [10.1021/acs.jpcllett.4c02848](https://doi.org/10.1021/acs.jpcllett.4c02848))

- Modelled excited state evolution in zirconium-based metal—organic frameworks carrying single atom catalyst mimics: studied 1<sup>st</sup> and 2<sup>nd</sup> order dynamic processes in the solid state (excitation energy transfer, charge transfer), assessed the structure-activity relationship (DOI: [10.1021/acs.energyfuels.1c02623](https://doi.org/10.1021/acs.energyfuels.1c02623))
- Designed a specialised experimental electrolytic cell to use for *operando* X-ray absorption experiments at a synchrotron beamline; characterised electronic structure of nanoscale core-shell titanium dioxide catalysts (DOI: [10.1021/acs.chemmater.4c02190](https://doi.org/10.1021/acs.chemmater.4c02190))
- Drafted and published an Account (self-review) describing results obtained by Professor Lin X. Chen's research group in the field of excitonic properties of framework solids (DOI: [10.1021/accounts.2c00137](https://doi.org/10.1021/accounts.2c00137))
- Managed and ensured safe operation of scientific instrumentation (Ar-filled glovebox (VAC), supercritical CO<sub>2</sub> manifold (Tousimis), UV-Vis with an integrating sphere (Shimadzu), fluorimeter (HORIBA Fluorolog); trained 20+ colleagues and drafted standard operating procedures

## TEACHING EXPERIENCE

**Graduate Teaching Assistant** at Northwestern University, Evanston, IL, USA **Sep. 2018 – Dec. 2023**

- Taught 5 quarters of introductory chemistry classes (Gen. Chem., Org. Chem.) with laboratory components: oversaw practical work, helped troubleshoot experiments, graded lab reports
- Mentored 1 visiting high school student through an introductory research project over 3 months

**Freelance Chemistry Tutor** **Sep. 2018 – Dec. 2023**

- Provided private tutoring services in General Chemistry to undergraduate students at Northwestern University

## SKILLS AND EXPERTISE

- **Laboratory:** hydrothermal synthesis, air-free methods, Schlenk line operation, chemical waste management
- **Characterisation of materials:** XANES, EXAFS, SAXS, powder XRD, SEM-EDS, XPS, XRF, UV-Vis spectroscopy, fluorescence spectroscopy, FT-IR, N<sub>2</sub> sorption isotherm and BET theory
- **Scientific computing:** Python, MATLAB, R; statistical analysis, modelling, principal component analysis; familiar with Reverse Monte-Carlo calculations, Bayesian inference, basic machine learning; Unix, Bash
- **Software:** Microsoft Office; scientific software (Athena + Artemis, XrayLarch, Thermo Advantage, Feff9, GSAS-II, Jana2006, SasView, SASfit, VESTA, Inca, Aztec, ImageJ); citation managers (Zotero, EndNote)
- **Languages:** fluent in English, native proficiency in Russian

## ADVANCED COURSEWORK AND PROFESSIONAL DEVELOPMENT

<i>Artificial Intelligence in Chemistry and Materials Science</i>	Kurnakov Institute (Moscow)	Jul. 2025
<i>Synchrotron and Neutron Methods Workshop</i>	Moscow State University (Moscow)	Dec. 2024
<i>Management for Scientists and Engineers Certificate</i>	Kellogg School of Business (Evanston)	Aug. 2023
<i>Scientific Writing for the General Audience</i>	Medill School of Journalism (Evanston)	May 2023
<i>Statistical Methods for Physicists and Astronomers</i>	Northwestern University (Evanston)	Dec. 2022
<i>X-ray Diffraction Methods in Materials Science</i>	Northwestern University (Evanston)	May 2019
<i>Responsible Conduct of Research Training</i>	Northwestern University (Evanston)	Dec. 2018

## HOBBIES AND INTERESTS

**Aquarium and Terrarium Keeping** **2019 – 2023**

- Maintained a 100-liter freshwater tank housing 5 different species of fish by rigorously and regularly testing water quality with qualitative colorimetric tests; ensured stable waste management and kept a healthy population of fish and live plants
- Maintained a 200-liter terrarium housing a ball python (1 meter long); ensured the animal's health by maintaining 80%+ humidity and installing two light fixtures supplying infrared and UV light; the animal was happy as demonstrated by behavioural indicators such as easy and timely shedding
- Found responsible new owners for the fish and the python while preparing for a long-distance move

## HOBBIES AND INTERESTS – CONTINUED

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### Creative Writing – Science Fiction

2021 onwards

- Took grand-prix in 3 online Russian short form fiction contests; reached finals in 4 more
- Published short form science fiction stories in paperback and in online publications
- Currently working on a novel while translating my older work into English

### OTHER LINKS AND PROJECTS

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GitHub: [github.com/PexcTa](https://github.com/PexcTa)

Personal Website: [pexcta.github.io](https://pexcta.github.io)

Porous Eden Mass Fractal Aggregate Generator: [kramar-pemfa.streamlit.app/](https://kramar-pemfa.streamlit.app/)  
(A teaching and visualisation tool on fractal aggregation)

### PUBLICATIONS

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Kuzenkova, A. S.; Plakhova, T. V.; Svetogorov, R. D.; Kulikova, E. S.; Trigub, A. L.; **Kramar, B. V.**; Yapaskurt, V. O.; Toropov, A. S.; Shaulskaya, M. D.; Tsybarenko, D. M.; Romanchuk, A. Y.; Kalmykov, S. N. Np(V) Double Carbonate with Magnesium: Synthesis, Solubility and Transformation. *Dalton Trans.* 2025.  
<https://doi.org/10.1039/D5DT00913H>.

**Kramar, B.V.**, Plakhova, T.V., Kuzenkova, A.S., Trigub, A.L., Svetogorov, R.D., Shiryayev, A.A., Nevolin, I.M., Yapryntsev, A.D., Baranchikov, A.E., Peters, G.S., Yapaskurt, V.O., Egorov, A.V., Kostyukov, I.A., Shaulskaya, M.D., Tsybarenko, D.M., Romanchuk, A.Y., Kalmykov, S.N., 2025. Formation of a new hydrated sodium–thorium phosphate from thorium dioxide and its subsequent phase evolution. *Dalton Trans.* **2025**, 54, 7360–7375.  
<https://doi.org/10.1039/D5DT00276A>

**Kramar, B. V.**; Bondarenko, A. S.; Koehne, S. M.; Diroll, B. T.; Wang, X.; Yang, H.; Schanze, K. S.; Chen, L. X.; Tempelaar, R.; Hupp, J. T. Unexpected Photodriven Linker-to-Node Hole Transfer in a Zirconium-Based Metal–Organic Framework. *J. Phys. Chem. Lett.* **2024**, 15 (46), 11496–11503.  
<https://doi.org/10.1021/acs.jpcllett.4c02848>.

Sarma, P. V.; **Kramar, B. V.**; Chen, L.; Sasmal, S.; Weingartz, N. P.; Huang, J.; Mitchell, J. B.; Kwak, M.; Chen, L. X.; Boettcher, S. W. Local Electric Field Effects on Water Dissociation in Bipolar Membranes Studied Using Core–Shell Catalysts. *Chem. Mater.* **2024**, 36 (24), 11863–11872. <https://doi.org/10.1021/acs.chemmater.4c02190>.

Elvington, M. C.; Ganesan, P.; Ward, P. A.; Liu, J.; Atilgan, A.; **Kramar, B. V.**; More, K.; Cullen, D.; Hupp, J. T.; Greenway, S.; Taylor Adams, W.; Colón-Mercado, H. R. Highly Active Oxygen Reduction Electrocatalysts Derived from an Iron–Porphyrin Framework. *PRX Energy* **2023**, 2 (4), 043008.  
<https://doi.org/10.1103/PRXEnergy.2.043008>.

Liu, J.; Prelesnik, J. L.; Patel, R.; **Kramar, B. V.**; Wang, R.; Malliakas, C. D.; Chen, L. X.; Siepmann, J. I.; Hupp, J. T. A Nanocavitation Approach to Understanding Water Capture, Water Release, and Framework Physical Stability in Hierarchically Porous MOFs. *J. Am. Chem. Soc.* **2023**, 145 (51), 27975–27983.  
<https://doi.org/10.1021/jacs.3c07624>.

Zheng, X.; Drummer, M. C.; He, H.; Rayder, T. M.; Niklas, J.; Weingartz, N. P.; Bolotin, I. L.; Singh, V.; **Kramar, B. V.**; Chen, L. X.; Hupp, J. T.; Poluektov, O. G.; Farha, O. K.; Zapol, P.; Glusac, K. D. Photoreactive Carbon Dioxide Capture by a Zirconium–Nanographene Metal–Organic Framework. *J. Phys. Chem. Lett.* **2023**, 14 (18), 4334–4341.  
<https://doi.org/10.1021/acs.jpcllett.3c00049>.

Sheridan, T. R.; Gaidimas, M. A.; **Kramar, B. V.**; Goswami, S.; Chen, L. X.; Farha, O. K.; Hupp, J. T. Noncovalent Surface Modification of Metal–Organic Frameworks: Unscrambling Adsorption Properties via Isothermal Titration Calorimetry. *Langmuir* **2022**, 38 (37), 11199–11209. <https://doi.org/10.1021/acs.langmuir.2c01223>.

**Kramar, B. V.**; Flanders, N. C.; Helweh, W.; Dichtel, W. R.; Hupp, J. T.; Chen, L. X. Light Harvesting Antenna Properties of Framework Solids. *Acc. Mater. Res.* **2022**, 3 (11), 1149–1159.  
<https://doi.org/10.1021/accountsmr.2c00137>.

**Kramar, B. V.**; Phelan, B. T.; Sprague-Klein, E. A.; Diroll, B. T.; Lee, S.; Otake, K.; Palmer, R.; Mara, M. W.; Farha, O. K.; Hupp, J. T.; Chen, L. X. Single-Atom Metal Oxide Sites as Traps for Charge Separation in the Zirconium-Based Metal–

Organic Framework NDC–NU-1000. *Energy Fuels* **2021**, 35 (23), 19081–19095.  
<https://doi.org/10.1021/acs.energyfuels.1c02623>.

## CONFERENCE TALKS

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**Kramar, B. V.**; Plakhova T. V.; Kuzenkova A. S.; Trigub A. L.; Romanchuk A. Yu.; Kalmykov S. N.; EXAFS analysis sheds light on the relationship between precipitation conditions and structural properties of double actinide carbonates and phosphates. *XXII Mendeleev Congress*, Sirius Federal Territory, Sochi, Russia, October 2024 (poster).

**Kramar, B. V.**; Plakhova T. V.; Kuzenkova A. S.; Trigub A. L.; Romanchuk A. Yu.; Kalmykov S. N.; Utilizing EXAFS spectroscopy to characterize structural properties of solid actinide-containing phases. *Synchrotron Radiation and Free Electron Lasers – 2024*, Budker Institute of Nuclear Physics, Novosibirsk, Russia, June 2024 (poster).

**Kramar, B. V.**; Phelan, B. T.; Sprague-Klein, E. A.; Diroll, B. T.; Lee, S.; Otake, K.-i.; Palmer, R.; Mara, M. W.; Farha, O. K.; Hupp, J. T.; et al. Single-Atom Metal Oxide Sites as Traps for Charge Separation in the Zirconium-Based Metal–Organic Framework NDC–NU-1000. *American Chemical Society National Meeting*, Chicago IL, August 2022 (poster).

## REFEREES

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Dr. Anna Romanchuk (Lomonosov Moscow State University, Moscow, Russia)

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Prof. Joseph T. Hupp (Northwestern University, Evanston, IL, USA)

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Prof. Lin X. Chen (Northwestern University, Evanston, IL, USA)

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