Jingshan S. Du, Ph.D.

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Website: http://dujingshan.tk/ ORCID: 0000-0002-4932-6699 GitHub: JingshanDu

Education

Northwestern University Evanston, IL

Ph.D., Materials Science and Engineering September 2021

Thesis: Complex Nanoparticle Systems: Structures, Structure–Property Relationships, and Dynamics

Supervised by Prof. Chad A. Mirkin and Prof. Vinayak P. Dravid

Certificate, Management for Scientists and Engineers, Kellogg School of Management August 2021

Zhejiang University Chu Kochen Honors College Hangzhou, China

B.Sc. (Hons), Engineering: Materials Science and Engineering June 2015

Thesis: Direct Observation of AgCl-Ag Transformation Dynamics Using In-situ Transmission Electron Microscopy

Supervised by Prof. Deren Yang and Prof. David A. Weitz

Research/Professional Experience

Pacific Northwest National Laboratory Richland, WA

Post Doctorate Research Associate, Physical & Computational Sciences Directorate 2021–present

Advisor: Dr. James J. De Yoreo

Washington Research Foundation Postdoctoral Fellow (*starting January 2022*)

Topics: nanoscale crystal formation, phase transformation, and thermodynamics

Northwestern University Evanston, IL

Research Assistant, International Institute for Nanotechnology 2015–2021

Faculty Advisors: Prof. Chad A. Mirkin and Prof. Vinayak P. Dravid

Ryan Fellow (2017–2020); Fellow, Hierarchical Materials Cluster Program (2016–2017)

Nanolithography Subgroup Leader (2019–2021)

Topics: nanoparticles as complex systems; nanoscale phase transformation; correlated and in-situ electron microscopy; combinatorial synthesis and characterization

Harvard University Cambridge, MA

Visiting Undergraduate, School of Engineering and Applied Sciences 2014–2015

Faculty Advisor: Prof. David A. Weitz

Topics: nanoscale interfacial reactions; in-situ electron microscopy; graphene liquid cells

University of California, Los Angeles Los Angeles, CA

Visiting Undergraduate, California NanoSystems Institute Summer 2014

Faculty Advisor: Prof. Xiangfeng Duan

Fellow, Cross-disciplinary Scholars in Science and Technology (CSST) Program

Topics: mixed oxide electrocatalysts for oxygen evolution reaction

Kuang-Chi Institute of Advanced Technology Shenzhen, China

Assistant Engineer/Intern, Development Center Summer 2013

Topics: design and fabrication of composite metamaterials

Zhejiang University Hangzhou, China

Undergraduate Research Assistant, State Key Laboratory of Silicon Materials 2013–2015

Faculty Advisors: Prof. Deren Yang and Prof. Hui Zhang

Ministry of Education of China National University Student Innovation Program Grant (2013–2014)

Topics: thermal-resistant metal/oxide hybrid nanostructures; shaped-controlled synthesis of noble metal nanocrystals

TEACHING AND MENTORING

Northwestern University Evanston, IL

Teaching Assistant, MAT_SCI 301 Materials Science Principles (with Labs) Fall 2017

Teaching Assistant, MAT_SCI 466 Analytical Electron Microscopy (with Labs) Spring 2018

Mentored graduate research:

Carolin B. Wahl, Ph.D. Student. Materials Science and Engineering 2019–2021

Topics: complex metal alloy nanoparticles

David D. Xu, Ph.D. Student, Chemistry 2019–2021

Topics: upconverting nanoparticle arrays and libraries

Mingue Shin, Visiting Ph.D. Student, Materials Science and Engineering 2019–2020

Topics: halide perovskite nano-LEDs

Qian Rong, Visiting Ph.D. Student, Materials Science and Engineering 2019

Topics: hierarchically porous multicomponent oxide electrocatalysts for oxygen evolution

Donghoon Shin, Ph.D. Student, Materials Science and Engineering 2018–2021

Topics: patterning and optoelectronics of halide perovskite nanocrystals

Mentored undergraduate research:

Benjamin Kaiser, REU (MRSEC) Summer 2018

Topics: graphene-liquid interaction

Juan Diego Martin, REU (NNCI/SHyNE) Summer 2017

Topics: graphene-encapsulated imaging of microbes

Kevin Qiu, REU (MRSEC) and Undergraduate Research Assistant 2016–2018

Topics: graphene-liquid interaction; graphene-encapsulated imaging of soft materials

SOCIETY SERVICE

SPIE Northwestern University Chapter Evanston, IL

President 2019–2020

Vice President 2018–2019

Coordinator, SPIE-MRSEC Student Seminar Series 2017–2018

EDITORIAL AND CONFERENCE ORGANIZATION

Guest Associate Editor, *Frontiers in Chemistry*, Nanotechnology for Natural Products, 2022

Conference Chair, *SPIE FOCUS: Light and Matter*, October 12th–13th, 2019. Evanston, IL

SIGNIFICANT RECOGNITIONS

Carl Samans Excellence Award, ASM Chicago Regional Chapter 2021

MRS Graduate Student Award, Materials Research Society 2021

IIN Outstanding Research Award, International Institute for Nanotechnology, Northwestern University 2020

SPIE Optics and Photonics Education Scholarship, SPIE 2020

Perkin Scholarship, Society of Chemical Industry America 2019

IPMI Sabin Metal Ron Bleggi Award, International Precious Metals Institute 2019

Park AFM Scholarship, Park Systems Inc. 2018

Top 100 Bachelor's Thesis Award, Zhejiang University 2015

Chu Kochen Scholarship (Presidential Award), Zhejiang University 2014

Chu Kochen Honors College Scholarship for Excellence (Dean's Award), Zhejiang University 2014

National Scholarship (Undergraduate), Ministry of Education of China 2014

Cross-disciplinary Scholars in Science and Technology (CSST) Award, University of California, Los Angeles 2014
Kwanjeong Educational Foundation Scholarship, Kwanjeong Educational Foundation and Zhejiang University 2012, '13, '14
Chou Pei-yuan Award for Youths in Science and Technology Innovation, Chou Pei-yuan Foundation 2010

MEDIA HIGHLIGHTS AND VOICES

Primarily featured by:

"Du awarded SPIE Optics and Photonics Education Scholarship" and "Scholarship awarded for study of nanoparticle structures and dynamics"
SPIE.org and International Institute for Nanotechnology News. May 2020

"Park AFM Scholarship Awards - JINGSHAN DU"
NanoScientific **2018**, *13*, 23–24 and the Park AFM website. May 2018

"Asking Myself at the Finish Line of College"
Zhejiang University Homepage. April 2015

Voices and opinions appeared in:

"As DFT matures, will it become a push-button technology?" by Sam Lemonick
Chemical & Engineering News **2019**, *97* (35), 16–19. September 2019

JOURNAL ARTICLES

[1] The Emergence of Valency in Colloidal Crystals Through Electron Equivalents.
Wang, S.†; Lee, S.†; **Du, J. S.**†; Partridge, B. E.; Cheng, H. F.; Zhou, W.; Dravid, V. P.; Lee, B.; Glotzer, S. C.; Mirkin, C. A. (†equal contribution)
Nature Materials **2021**, in press.

[2] Site-Isolated Upconversion Nanoparticle Arrays Synthesized in Polyol Nanoreactors.
Xu, D. D.‡; Wahl, C. B.‡; **Du, J. S.**; Irgen-Gioro, S.; Weiss, E. A.; Mirkin, C. A. (‡mentored student)
The Journal of Physical Chemistry C **2021**, in press.

[3] Galvanic Transformation Dynamics in Heterostructured Nanoparticles.
Du, J. S.; He, K.; Xu, Y.; Wahl, C. B.‡; Xu, D. D.‡; Dravid, V. P.; Mirkin, C. A. (‡mentored student)
Advanced Functional Materials **2021**, *in press*. DOI:10.1002/adfm.202105866

[4] Bidirectional Nanomodification Enables Hierarchically Structured Mixed Oxide Electrodes for Oxygen Evolution.
Rong, Q.†‡; **Du, J. S.** †; Chen, X.; Liu, Q.; Dravid, V. P. (†equal contribution, ‡mentored student)
Small **2021**, *17* (17), 2007287.
►Highlighted by Northwestern Engineering News; also reprinted by International Institute for Nanotechnology News.

[5] Twin Pathways: Discerning the Origins of Multiply Twinned Colloidal Nanoparticles.
Du, J. S.; Zhou, W.; Ripich, S. M.; Mirkin, C. A.
Angewandte Chemie International Edition **2021**, *60* (13), 6858–6863

[6] Position- and Orientation-Controlled Growth of Wulff-Shaped Colloidal Crystals Engineered with DNA.
Sun, L.; Lin, H.; Li, Y.; Zhou, W.; **Du, J. S.**; Mirkin, C. A.
Advanced Materials **2020**, *32* (47), 2005316.

[7] Halide Perovskite Nanocrystal Arrays: Multiplexed Synthesis and Size-dependent Emission.
Du, J. S.†; Shin, D.†‡; Stanev, T. K.; Musumeci, C.; Xie, Z.; Huang, Z.; Lai, M.; Sun, L.; Zhou, W.; Stern, N. P.; Dravid, V. P.; Mirkin, C. A. (†equal contribution, ‡mentored student)
Science Advances **2020**, *6* (39), eabc4959.
►Highlighted by *Nature Electronics* **2020**, *3* (10), 582, *Perovskite-Info*, and Northwestern Engineering News; also reprinted by International Institute for Nanotechnology News.

[8] Chain-End Functionalized Polymers for the Controlled Synthesis of Sub-2 nm Particles.
Chen, P.-C.; Liu, Y.; **Du, J. S.**; Meckes, B.; Dravid, V. P.; Mirkin, C. A.
Journal of the American Chemical Society **2020**, *142* (16), 7350–7355.

[9] Light-Responsive Colloidal Crystals Engineered with DNA.
Zhu, J.; Lin, H.; Kim, Y.; Yang, M.; Skakuj, K.; **Du, J. S.**; Lee, B.; Schatz, G. C.; Van Duyne, R. P.; Mirkin, C. A.
Advanced Materials **2020**, *32* (8), 1906600.

[10] Colloidal Crystal "Alloys."
Wang, S.; **Du, J. S.**; Diercks, N. J.; Zhou, W.; Roth, E. W.; Dravid, V. P.; Mirkin, C. A.
Journal of the American Chemical Society **2019**, *141* (51), 20443–20450.

[11] Particle Analogs of Electrons in Colloidal Crystals.
Girard, M.†; Wang, S.†; **Du, J. S.**†; Das, A.†; Huang, Z.; Dravid, V. P.; Lee, B.; Mirkin, C. A. Olvera de la Cruz, M. (†equal contribution)
Science **2019**, *364* (6446), 1174–1178.
►Highlighted by *MRS Bulletin* **2019**, *44* (11), 837, *Quanta Magazine*, *The Economist Espresso*, *Northwestern Now*, and Argonne National Laboratory Press Release; also reprinted by PHYS.ORG, Advanced Photon Source Science Highlights, *Civil + Structural Engineer*, Nanowerk News, etc.

[12] Interface and Heterostructure Design in Polyelemental Nanoparticles.
Chen, P.-C.; Liu, M.; **Du, J. S.**; Meckes, B.; Wang, S.; Lin, H.; Dravid, V. P.; Wolverton, C.; Mirkin, C. A.
Science **2019**, *363* (6430), 959–964.
► Highlighted by *Nano Today* **2019**, *26*, 5-6 and *Northwestern Now*; also reprinted by *Materials Today* News, PHYS.ORG, ScienceDaily, Nanowerk News, etc.

[13] Catalyst Discovery Through Megalibraries of Nanomaterials.
Kluender, E. J.†; Hedrick, J. L.†; Brown, K. A.; Rao, R.; Meckes, B.; **Du, J. S.**; Moreau, L. M.; Maruyama, B.; Mirkin, C. A. (†equal contribution)
Proceedings of the National Academy of Sciences of the United States of America **2019**, *116* (1), 40–45.
► Highlighted by *Science* News, *Nature Review Chemistry* **2019**, *3* (2), 66, and *Northwestern Now*; also reprinted by PHYS.ORG, Nanowerk News, etc.

[14] Windowless Observation of Evaporation-Induced Coarsening of Au-Pt Nanoparticles in Polymer Nanoreactors.
Du, J. S.; Chen, P.-C.; Meckes, B.; Kluender, E. J.; Xie, Z.; Dravid, V. P.; Mirkin, C. A.
Journal of the American Chemical Society **2018**, *140* (23), 7213–7221.
► Highlighted by International Institute for Nanotechnology News.

[15] Multi-Stage Transformation and Lattice Fluctuation at AgCl-Ag Interface.
Du, J. S.; Park, J.; Kim, Q.; Jhe, W.; Dravid, V. P.; Yang, D.; Weitz, D. A.
The Journal of Physical Chemistry Letters **2017**, *8* (23), 5853–5860.

[16] The Structural Evolution of Three-component Nanoparticles in Polymer Nanoreactors.
Chen, P.-C.; **Du, J. S.**; Meckes, B.; Huang, L.; Xie, Z.; Hedrick, J. L.; Dravid, V. P.; Mirkin, C. A.
Journal of the American Chemical Society **2017**, *139* (29), 9876–9884.

[17] Solution-Phase Photochemical Nanopatterning Enabled by High-Refractive-Index Beam Pen Arrays.
Xie, Z.†; Gordiichuk, P.†; Lin, Q.-Y.; Meckes, B.; Chen, P.-C.; Sun, L.; **Du, J. S.**; Zhu, J.; Liu, Y.; Dravid, V. P.; Mirkin, C. A. (†equal contribution)
ACS Nano **2017**, *11* (8), 8231–8241.
► Highlighted by *ACS Nano* **2017**, *11* (9), 8537–8541.

[18] The Structural Fate of Individual Multicomponent Metal-Oxide Nanoparticles in Polymer Nanoreactors.
Du, J. S.†; Chen, P.-C.†; Meckes, B.; Xie, Z.; Zhu, J.; Liu, Y.; Dravid, V. P.; Mirkin, C. A. (†equal contribution)
Angewandte Chemie International Edition **2017**, *56* (26), 7625–7629.

[19] Embedding Ultrafine Pt Nanoparticles at Ceria Surface for Enhanced Thermal Stability.
Du, J. S.†; Bian, T.†; Yu, J.; Jiang, Y.; Wang, X.; Yan, Y.; Li, Y.; Jin, C.; Zhang, H.; Yang, D. (†equal contribution)
Advanced Science **2017**, *4* (9), 1700056.

[20] Intermetallic Nanocrystals: Syntheses and Catalytic Applications.
Yan, Y.; **Du, J. S.**; Gilroy, K. D.; Yang, D.; Xia, Y.; Zhang, H.
Advanced Materials **2017**, *29* (14), 1605997. (**Invited Review**)

[21] Developing an Aqueous Approach for Synthesizing Au and M@Au (M = Pd, CuPt) Hybrid Nanostars with Plasmonic Properties.
Du, J.; Yu, J.; Xiong, Y.; Lin, Z.; Zhang, H.; Yang, D.
Physical Chemistry Chemical Physics **2015**, *17* (2), 1265–1272.

[22] Kinetically-controlled Growth of Cubic and Octahedral Rh-Pd Alloy Oxygen Reduction Electrocatalysts with High Activity and Durability.
Yan, Y.†; Zhan, F.†; **Du, J.**; Jiang, Y.; Jin, C.; Fu, M.; Zhang, H.; Yang, D. (†equal contribution)
Nanoscale **2015**, *7* (1), 301–307.

[23] Facile Synthesis of High-quality Pt Nanostructures with Controlled Aspect-ratio for Methanol Electro-oxidation.
Li, Y.; Bian, T.; **Du, J.**; Xiong, Y.; Zhan, F.; Zhang, H.; Yang, D.
CrystEngComm **2014**, *16* (36), 8340–8343.

[24] Langmuir Isotherm in Solution Adsorption Experiment.
Du, J.
Research & Exploration in Laboratory **2014**, *33* (10), 207–210.

[25] A Design of a Remote-Control Telescope System for High-School Students.
Du, J.; Liu, Y.; Fu, S.; Lin, L.
Astronomical Research & Technology **2013**, *10* (2), 194–200. (**Front Cover**)

INVITED TALKS

[1] From Making Crystals to Seeing Crystal Evolution: Developing New Imaging Capabilities to Understand Molecular Icing.
Pacific Northwest National Laboratory Linus Pauling Seminar, February 24th, 2021. Online Virtual Meeting.

[2] Halide Perovskite Nanocrystal Arrays: Multiplexed Synthesis and Size-Dependent Emission.
SPIE Student Seminar Series, August 4th, 2020. Online Virtual Meeting.

[3] Accelerating Complex Nanomaterial Discovery Using A Combinatorial Library Approach (Award Address).
43rd International Precious Metals Institute Annual Conference, June 15th–18th, 2019. Reno, NV.

[4] Classical Electron Equivalent Nanoparticles in Metal-like Colloidal Crystals.
36th John E. Hilliard Symposium, Northwestern University, May 16th, 2019. Evanston, IL.

CONTRIBUTED PRESENTATIONS

[1] Elucidating the Plasmonic Modes in Metal Nanojunctions with Nanoparticle Libraries.
Du, J. S.; Cherqui, C.; Schatz, G. C.; Dravid, V. P.; Mirkin, C. A.
2021 MRS Spring Meeting. April 18th–23rd, 2021. Online Virtual Meeting. (Oral talk)

[2] Multiplexed Nanocrystal Arrays of Halide Perovskites.
Du, J. S.; Shin, D.; Dravid, V. P.; Mirkin, C. A.
2021 MRS Spring Meeting. April 18th–23rd, 2021. Online Virtual Meeting. (Oral talk)

[3] Microscopy-Based Approaches to Characterizing Analogs of Classical Electrons in Colloidal Crystals Engineered with DNA.
Du, J. S.; Wang, S.; Dravid, V. P.; Mirkin, C. A.
Microscopy & Microanalysis 2020. August 3rd–7th, 2020. Online Virtual Meeting. (Oral talk)

[4] Hierarchically Structured Mixed Oxide Electrodes for Oxygen Evolution Reaction: A Multimodal Electron Microscopy Study.
Du, J. S.; Rong, Q.; Chen, X.; Liu, Q.; Dravid, V. P.
Microscopy & Microanalysis 2020. August 3rd–7th, 2020. Online Virtual Meeting. (Oral talk)

[5] Polymer Nanoreactor Approach for Combinatorial Investigation of Complex Nanoparticles.
Du, J. S.; Dravid, V. P.; Mirkin, C. A.
Gordon Research Conference & Seminar: Crystal Growth and Assembly, June 22nd–28th, 2019. Manchester, NH. (Poster)

[6] Attoliter Polymer Reactors as Combinatorial Tools for Understanding Alloy Nanocrystal Structure–Function Relationship.
Du, J. S.; Dravid, V. P.; Mirkin, C. A.
257th ACS National Meeting, March 31st–April 4th, 2019. Orlando, FL (Oral talk)

[7] Site-Specific Polymer Nanoreactors for Studying Complex Nanoparticles Using Correlative Electron Microscopy.
Du, J. S.; Chen, P.-C.; Dravid, V. P.; Mirkin, C. A.
2018 MRS Spring Meeting, April 2nd–6th, 2018. Phoenix, AZ. (Oral talk)

[8] Using STEM to Probe the in-situ Dynamics of Multimetallic Nanoparticles Grown in Polymer Nanoreactors.
Du, J. S.; Chen, P.-C.; Dravid, V. P.; Mirkin, C. A.
Microscopy & Microanalysis 2017, August 6th–10th, 2017. St. Louis, MO. (Oral talk)

[9] Multi-stage Transformation and Lattice Fluctuation at AgCl-Ag Nanoparticle Interface.
Du, J. S.; Park, J.; Kim, Q.; Dravid, V. P.; Yang, D.; Weitz, D. A.
253rd ACS National Meeting, April 2nd–6th, 2017. San Francisco, CA. (Oral talk)

[10] Surface-embedded Pt/CeO_2 Hybrid Nanostructure with High Catalytic Activity and Thermal Stability.
Du, J.; Yu, J.; Bian, T.; Jiang, Y.; Zhang, H.; Yang, D.
7th National Meeting of Undergraduate Innovation and Entrepreneurship, October 18th–19th, 2014. Xi'an, China. (Oral talk, **Outstanding Paper Award**)
► Highlighted by Zhejiang University Undergraduate School News.

[11] Controlled Synthesis of Au and M@Au Nanostars and Their LSPR Properties.
Du, J.; Zhang, H.; Yang, D.
Graduate Joint Forum on Technologies & Sensors, Cyrus Tang Center for Sensor Materials and Applications, Zhejiang University, June 13th, 2014. Hangzhou, China. (Poster)

PATENTS AND PATENT APPLICATIONS (PUBLISHED)

[1] Structurally modified nanosheets of metal oxides and related methods.
US 2021/0230753. U.S. Patent Application.

[2] Halide perovskite nanocrystal array and its preparation.
WO 2021/188168. International Patent Application (PCT).

[3] Polymer-assisted synthesis of ultrasmall nanoparticles.
US 2020/0310248. U.S. Patent Application.

[4] Device and method for fluid flow rate measurement.
CN 103063868. China Patent.

ACADEMIC COMPETITIONS

Outstanding Winner, Zhejiang University Challenge Cup Undergraduate Academic Research Contest 2015
Report Title: Platinum-based Nanostructures with High Catalytic Activity and Thermal Stability

Meritorious Winner, Interdisciplinary Contest in Modeling (MCM/ICM, COMAP) 2014
Report Title: Bibliometrics, Biosystem, Better Choice: The Interdisciplinary Analysis of Network Influence

First Prize, Kuang-Chi Metamaterials Mathematical Modeling Contest 2013
Report Title: Microstructural Effect on the Electromagnetic Responses of Metamaterials

First Prize, Chinese Adolescents Science and Technology Innovation Contest 2010
Report Title: Design and Implementation of Quantitative Astronomical Experiments for High School Students

POPULAR SCIENCE AND SECONDARY EDUCATION ARTICLES

China Science and Technology Education, 2011 (11), 27–29. *Amateur Astronomer*, 2010 (4), 72–73. *Physics Bulletin*, 2010 (6), 20–24. *Science in 24 Hours*, 2009 (7–8), 13–15. *Science in 24 Hours*, 2009 (7–8), 16–17. *Chinese National Astronomy*, 2009 (7), 110. *Science in 24 Hours*, 2009 (6), 38–39.