Bo Hyung Ryoo

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RESEARCH FOCUS

Masters in Chemistry, Inorganic Nanomaterial Experiment *and* Theory.

EDUCATION

University of Pittsburgh, Chemistry Department — Pittsburgh, PA
Master in Chemistry, Inorganic Chemistry — *Aug. 2016 - Oct. 2019*
Research Advisor: Jill E. Millstone — GPA:3.85

"Influence of Phosphine and Halide Ligands on the Properties of Undecagold Nanoclusters"

University of Pittsburgh, Chemistry Department — Pittsburgh, PA
Bachelor of Art and Science in Chemistry — *Aug. 2012 - Apr. 2016*
Minor: Physics

Saint Joseph High School — Bridgeport, CT
Sept. 2010 - Jun. 2012

RESEARCH EXPERIENCE

SionTech Co. Ltd. — Daejeon, South Korea
Senior Researcher — *Sep 2019 - present*
The research focuses on designing improved capacitative deionization (CDI) cells, which can be used for commercial and industrial water purification systems.

- Developing new materials and new operating methods for CDI system
- Designing and operating pilot-level production line for the components in CDI (ex. ion-exchange membrane, carbon electrodes)

Furthermore, my research includes developing new methods on large-scale chemical depolymerization of polyesters for plastic-recycling.

- Developing proprietary methods for cost-effective chemical depolymerization

- Operating pilot-level chemical plant to depolymerize polyethylene terephthalate (PET) into different monomers

ChemRep
Computer Scientist *May 2019 - present*
The research involves writing and open-sourcing complete python library used to execute machine learning (ML) algorithm for molecular representation

- Parsing information from common molecule coordination files and categorize them for representations
- "Open-sourcing python scripts on molecular representations for machine learning"
- With use of trained ML algorithm, predict properties of new organic molecules

University of Pittsburgh Pittsburgh, PA
Graduate Student Researcher *Apr. 2016 - Oct. 2019*
The research involves synthesizing and analyzing atomically precise gold nanoclusters along with the use of density functional theory (DFT)

- "X-type and L-type Ligand dependent properties on the properties of gold nanoclusters"
- Different synthetic and purification methods produced gold based nanoclusters passivated wanted ligands. The suite of nanoclusters were characterized in order to understand the surfacial influence on the properties of metallic nanomaterials
- Used CP2K to model the nanoclusters and compared theoretical properties with the experimentally observed properties

University of Pittsburgh Pittsburgh, PA
Undergraduate Student Researcher for Dr. Jill Millstone *Sept. 2013 - Apr. 2016*
The research involves synthesizing and analyzing gold nanoparticles along with the use of DFT

- "Different substitutions of mercaptobenzoic acids on the surface of gold nanoparticles"
- Syntheses, purification, characterization of gold nanoparticles with various sulfur-containing ligands
- Used GPAW to model the surface of the gold interacting with surface ligands

Carnegie Mellon University Pittsburgh, PA
Undergraduate Student Researcher for Dr. David Yaron *Apr. 2014 - Oct. 2014*
The research involved hotbit density dunctional tight binding theory (DFTB)calculation on atomic simulation environment (ASE) for faster and accurate geometry optimization

- "Using hotbit calculator to geometrically optimize small gold nanoparticles"

- Used python as computing languages
- Made various parameters for atoms and molecules

Korean Advanced Institute of Science and Technology Daejeon, S. Korea

High School Student Shadowing Under Dr. Yun-Ho Lee *May. 2011 - Oct. 2011*

The research involved the synthesis and design of catalytic metal complexes for industrial energy efficiency

- Shadowed graduate students to learn synthesis and analysis of ligands
- Worked in inert conditions (i.e. glovebox)

PUBLISHED

9. Ryoo, B-H.; Lee, K-H.; Kang, K-S.; Kang, S-W.; Kim, Y-H.; Do, S-A. (Siontech Co, Ltd). Chemical recycling method of polyester-based polymer waste. *KR. Patent* WO 10-2021-00871497, Jul. 2, 2021. *patent pending*
8. Kang, K-S.; Lee, K-H.; Lee, H-I.; Ryoo, B-H.; Park, N-S.; Lee, K-H. (Siontech Co, Ltd). Energy-saving Ion Adsorption/Desorption Water Purification Apparatus and Energy-saving Water Purification Method. *US. Patent* NO 17,186,985, Feb. 26, 2021. *patent pending*
7. Lee, K-H.; Ryoo, B-H.; Do, S-A.; Kang, K-S. (Siontech Co, Ltd). Capacitive Desalination Cell Performance Inspection Device. *KR. Patent* WO 10-2020-0154282, Nov. 18, 2020. *patent pending*
6. Kim, M-Y.; Kang, K-S.; Lee, K-H.; Ryoo, B-H. (Siontech Co, Ltd). Capacitive Deionization Electrode and Manufacturing Method Thereof. *KR. Patent* WO 10-2020-0040781, Apr. 3, 2020. *patent pending*
5. Kang, K-S.; Lee, K-H.; Park, N-S.; Yoo, H-W.; Ryoo, B-H. (Siontech Co., Ltd., Kyung Dong Navien Co., Ltd.). Deionization Electrode, Apparatus and Method for Deionization Electrode, Electrode Module and Deionization Module. *US. Patent* NO US2021221711A1, Jan. 21, 2020. *patent pending*
4. Kang, K-S.; Lee, K-H.; Ryoo, B-H. (Siontech Co., Ltd.). Apparatus and method for removing boron contained in radioactive waste liquid. *KR. Patent* WO 10-2020-0004027, Jan. 13, 2020. *patent pending*
3. Ryoo, B-H., "Influence of Phosphine and Halide Ligands on the Properties of Undecagold Nanoclusters", *M.S. Thesis,* **The University of Pittsburgh,**, Pittsburgh, PA, (2019).
2. B-H. Ryoo, S.E. Crawford, N.L. Tolman, P.J. Straney, J. E. Millstone, "Controlling Gold Nanoparticle Shape Using Household Antioxidants: A Spectroscopy Study" *in preparation*
1. S.E. Crawford, C.M. Andolina, D.C. Kaseman, B-H. Ryoo, A.M. Smith, K.A. Johnston, J. E. Millstone, "Efficient Energy Transfer from Near-Infrared Emitting Gold Nanoparticles to Pendant Ytterbium(III)", *J Am Chem Soc.* **139(49)**, 17767-17770 (2017).

POSTER PRESENTATION

- **Pittsburgh Quantum Institute** *Apr. 2018*
  Pittsburgh, PA
  "Relativistic Effects in Nanoparticle Ligands: Understanding the Influence of Heavy Atoms in Photoluminescene of Noble Metal Nanoparticles"

- **Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy** *Feb. 2018*
  Orlando, FL
  "Relativistic Effects in Nanoparticle Ligands: Understanding the Influence of Heavy Atoms in Photoluminescene of Noble Metal Nanoparticles"

TECHNIQUES

Characterization

- X-ray Diffractometry **(XRD)**
  Bruker Apex II diffractometer
- UV-visible spectroscopy **(UV-Vis)**
  Cary 5000 spectrophotometer
- Photoluminescence Spectroscopy
  Horiba Jobin-Yvon NanoLog spectrometer
- Transmission Electron Microscope **(TEM)**
  FEI Morgani 268 Transmission Electron Microscope
  JEOL JEM2100F Transmission Electron Microscope
  Hitachi 9500 Transmission Electron Microscope
- Fourier Transform Infrared Spectroscopy **(FTIR)**
  Bruker Vertex-70LS FTIR and Hyperion 2000 FTIR Microscope
- Raman Spectroscopy **(Raman)**
  Renishaw inVia Raman microscope
- Electron Paramagnetic Resonance Spectroscopy **(EPR)**
  Bruker EMXNano Spectrometer
- Inductively Coupled Plasma Optical Emission Spectrometry **(ICP-OES)**
  ThermoFisher ICAP 6300 Spectrometer

Wet Lab Techniques

- Metal nanomaterial syntheses
- Inert atmosphere techniques and syntheses
- Crystallization
- Pilot scale productions and engineerings

Computer Languages and Computational Chemistry

- Python
- Javascript
- React-Native

- Model and graphic design
  - pyplot
  - Visual Molecular Dynamics
  - Blender
  - Gimp
- Atomic Simulation Environment calculators (python based)
  - hotbit (DFTB)
  - GPAW (DFT)
  - ORCA (DFT)
- Other calculators
  - CP2K (DFT)
  - TURBOMOLE (DFT)

TEACHING EXPERIENCE

@ University of Pittsburgh, Chemistry Dept.:

CHEM1430: Physical Chemistry Laboratory Fall 2016 - Spring 2019

Lead the lab course in teaching senior chemistry students with various instrumental methods and underlying physical theories (head instructor: Dr. Eugene Wagner)

"Very knowledgeable about all of the labs and how to perform them.", "Bo did a nice job of checking in on lab groups throughout the duration of the lab to make sure all lab groups were getting through the labs in a timely manner. It was also evident that he cared about our progress and he often gave us suggestions in order for us to improve our grades on the lab.", "Great being helpful to everyone during lab regardless of what we needed help with. Maintained a good lab environment to help us learn and still have a good time. Was willing to put in the work to help us succeed", "Very accessible and willing to answer questions and emails."

CHEM0110: General Chemistry I Fall 2017

Held recitations for freshman students (head instructor: Dr. Adrian Michaels)

Laboratory Manuals for Honors General Chemistry Summer 2017

Produced a compile of new and updated lab manuals for freshman honors student interested in chemistry (head instructor: Dr. Eugene Wagner)

CHEM0250: General Chemistry for Engineers I Fall 2016

Held recitations for freshman engineering students (head instructor: Dr. Hanna Morris)

@ University of Pittsburgh, Mathematics Dept.:

MATH0020: College Algebra Spring 2015 - Spring 2016

Held recitations (head instructor Dr. Robert O'Mara)

Math tutor Spring 2015 - Spring 2016

Worked in math assistance center (MAC) to help other undergraduate students with questions ranging from college algebra to calculus and theoretical mathematics

@ University of Pittsburgh, Chemistry Dept.:

Organic Chemistry I & **II** Spring 2015 - Fall 2015

Lead the weekly study session to review problem sets as UTA (head instructors: Drs. Kazunori Koide and Erika Huston)

STEM-ulate Learning Sept. 2014

Mentor for first year college students studying chemistry

General Chemistry Fall 2013 - Spring 2014

Undergraduate tutor other undergraduates

FELLOWSHIPS

- Summer Research Fellowship *Summer 2016*
- Art & Science Tuition Scholarship *Fall 2017 - Spring 2018*

ONLINE CERTIFICATES

- Google IT Automation with Python Professional Certificate *Coursera: Google*
- Machine Learning *Coursera: Standford University*
- Leading People and Teams Specialization *Coursera: University of Michigan*

LANGUAGE EFFICIENCY

Korean	Fluent
English	Fluent
Russian	Early Intermediate

CIVIL STATUS

Military Service **Currently serving** (Sep 2019 - Sep 2022)

OUTREACH

- **Faculty Advisor** *Apr. 2018 - Apr. 2019*
  Sigma Alpha Epsilon, Chi-Omega Chapter Pittsburgh, PA
- **Student Affiliates of the American Chemical Society** *Sep. 2014 - Apr. 2016*
  University of Pittsburgh Pittsburgh, PA
- **Carnegie Chemistry Carnival** *Oct. 2014*
  Mellon Institute Pittsburgh, PA