

## *Ill Ryu*

Seoul National University  
Materials Science and Engineering  
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### **Education**

**Stanford University** (Palo Alto, CA) April, 2013

Ph.D. in Materials Science and Engineering with Minor in Mechanical Engineering

M.S. in Materials Science and Engineering

Principal Advisor: Prof. William D. Nix, Co-advisor: Prof. Wei Cai

**Seoul National University** (Seoul, Korea) January, 2005

M.S. in Materials Science and Engineering

B.S. in Materials Science and Engineering

### **Professional Experience**

**Assistant Professor** March, 2024 - Present

Department of Mechanical Engineering, Seoul National University, South Korea

**Assistant Professor** July, 2016 - February, 2024

Department of Mechanical Engineering, University of Texas at Dallas

**Postdoctoral Researcher** April, 2013 – June, 2016

School of Engineering, Brown University

Principal Investigator: Prof. Huajian Gao

**Digital simulation Engineer** January, 2007 – April, 2008

Renault Samsung Motors (Suwon, Korea)

### **Awards and Fellowships**

- Ralph E. Powe Junior Faculty Enhancement Awards, June 1, 2017~ May 31, 2018
- Grant support, Sigma Xi Monie A. Ferst Award Symposium, Atlanta, Nov. 16, 2017
- Grant support, The Schöntal Symposium on Dislocation-based Plasticity, Germany, Feb. 28, 2016
- Hyundai Global top talent forum– Best Presentation Awards (San Francisco, USA), Aug. 23, 2014
- Outstanding Presentation Awards by young Researchers in ICF13 (Beijing, China), June 21, 2013
- NSF fellowship - NSF summer institute (Northwestern University, USA), March 12, 2010
- Honor fellowship (Sinyang cultural foundation and Seoul National University, Korea), 1998~2003

## **Journal Publications**

(\* The detailed information is available at <http://www.scopus.com/authid/detail.url?authorId=36621566800>)

1. Phu Cuong Nguyen, Ill Ryu, “Mesoscale Dislocation Dynamics Modeling of Incipient Plasticity under Nanoindentation”, *Materialia*, 32, 101956 (2023).
2. Nicole K. Aragon, Ye-eun Na, Phu Cuong Nguyen, Dongchan Jang, Ill Ryu, “Micro-beam bending of FCC single and bicrystals: A comparison between dislocation dynamics simulations and experiments”, *Materialia*, 32, 101941 (2023).
3. Jamie D. Gravell, Jaehyun Cho, Seungjoon Lee, Sylvie Aubry, Ill Ryu, “Prediction of dislocation - grain boundary interactions in FCC aluminum bicrystals using a modified continuum criterion and machine learning methods”, *Materialia*, 31, 101874 (2023).
4. Nicole K. Aragon, Jamie D. Gravell, Ill Ryu, “Dislocation interactions at the grain boundary in FCC bicrystals: An atomistically-informed dislocation dynamics study”, *Acta Materialia*, 223, 117455 (2021).
5. Nicole K. Aragon, Sheng Yin, Hojun Lim, Ill Ryu, “Temperature Dependent Plasticity in BCC Micropillars”, *Materialia*, 19, 101181 (2021).
6. Jamie D. Gravella, Sanryun Lee, Seunghwa Ryu, Ill Ryu, “Effect of size and orientation on stability of dislocation networks upon torsion loading and unloading in FCC metallic micropillars”, *Acta Materialia*, 214, 117010 (2021).
7. Gyuho Song, Nicole K. Aragon, Ill Ryu, Seok-Woo Lee, “Low-temperature failure mechanism of [001] niobium micropillars under uniaxial tension”, *Journal of Material Research* 36, 2371–2382 (2021) (**Invited**).
8. Sangryun Lee, Ill Ryu, Seunghwa Ryu, “Stacking fault energy-dependent plastic deformation of face-centered-cubic metal nanowires under torsional loading”, *Extreme Mechanics Letters*, 40, 100895 (2020).
9. Ill Ryu, Jamie D. Gravell, Wei Cai, William D. Nix, Huajian Gao, “Intrinsic size dependent plasticity in BCC micro-pillars under uniaxial tension and pure torsion”, *Extreme Mechanics Letters*, 40, 100901 (2020).
10. Jamie D. Gravell, Ill Ryu, “Latent hardening/softening behavior in tension and torsion combined loadings of single crystal FCC micropillars”, *Acta Materialia*, 190, 58-69 (2020).
11. Taejoon Park, Hyunki Kim, Ill Ryu, Farhang Pourboghrat, Rasoul Esmaeilpour, “A multi-scale modelling of 3rd generation advanced high strength steels to account for anisotropic evolution of yield surface and plastic potential”, *Journal of Physics: Conference Series*, 1063, 012019 (2018).
12. Ill Ryu, Wei Cai, William D. Nix, Huajian Gao, “Anisotropic size dependent plasticity in FCC micropillars under”, *Journal of Minerals, Metallurgy and Materials* 68, 253–260 (2016) (**Invited**).
13. Ill Ryu, Wei Cai, William D. Nix, Huajian Gao, “Stochastic behaviors in plastic deformation of face-centered cubic micropillars governed by surface nucleation and truncated source operation”, *Acta Materialia*, 95, 176–183 (2015).
14. Seok Woo Lee, Hyun-Wook Lee, Ill Ryu, Huajian Gao, William D. Nix, Yi Cui, “Kinetics and fracture resistance of lithiated silicon nanostructure pairs controlled by their mechanical interaction”, *Nature Communications*, 6, 7533 (2015).

15. Seok Woo Lee, Ill Ryu, William D. Nix, Yi Cui, "Fracture of Crystalline Germanium during Electrochemical Lithium Insertion", *Extreme Mechanics Letters*, 2, 15-19 (2015).
16. Xingcheng Xiao, Weidong Zhou, Youngnam Kim, Ill Ryu, Meng Gu, Chongmin Wang, Gao Liu, Zhongyi Liu, Huajian Gao, "Regulated Breathing Effect of Silicon Negative Electrode for Dramatically Enhanced Performance of Li-Ion Battery", *Advanced Functional Materials*, 25, 1426-1433 (2015).
17. Lucas Berla, Seok Woo Lee, Ill Ryu, William D. Nix, Yi Cui, "Robustness of amorphous silicon during the initial lithiation/delithiation cycle", *Journal of Power Source*, 258, 253-259 (2014).
18. Seok-Woo Lee, Yintong Cheng, Ill Ryu, Julia R. Greer, "Cold-temperature deformation of nano-sized tungsten and niobium as revealed by in-situ nano-mechanical experiments", *Science China Technological Sciences*, 57, 652-662 (2014), **Invited paper, highlighted as a cover page of journal, Featured as an editor's selection in National Science Review of China.**
19. Ill Ryu, Seok Woo Lee, Yi Cui, William D. Nix, "Microscopic model for fracture of crystalline Si nanopillars during lithiation", *Journal of Power Source*, 255, 274-282 (2014).
20. Yusuke Matsuda, Ill Ryu, Sean W. King, Reinhold H. Dauskardt, "Toughening Thin Film Structures by Ceramic-Like Amorphous Silicon Carbide Layers", *Small*, 10, 253-257 (2014).
21. Ill Ryu, Wei Cai, William D. Nix, "Plasticity of BCC micro-pillars controlled by competition between dislocation multiplication and depletion", *Acta Materialia*, 61, 3233-324 (2013).
22. Matthew T. McDowell, Ill Ryu, Seok Woo Lee, Chongmin Wang, William D. Nix, Yi Cui, "Studying the Kinetics of Crystalline Si Lithiation with In-Situ Transmission Electron Microscopy", *Advanced Materials*, 24, 6034-6041 (2012).
23. Hui Wu, Gerentt Chan, Jang Wook Choi, Ill Ryu, Yan Yao, Matthew T. McDowell, Seok Woo Lee, Ariel Jackson, Yuan Yang, Liangbing Hu, Yi Cui, "Stable Cycling of Double-Walled Silicon Nanotube Battery Anodes through Solid-Electrolyte Interphase Control", *Nature Nanotechnology*, 7, 310-315 (2012).
24. Yan Yao, Matthew T. McDowell, Ill Ryu, Hui Wu, Nian Liu, Liangbing Hu, William D. Nix, Yi Cui, "Interconnected Silicon Hollow Nanospheres for Lithium-Ion Battery Anodes with Long Cycle Life", *Nano Letters*, 11, 2949-2954 (2011).
25. Matthew T. McDowell, Seok Woo Lee, Ill Ryu, Hui Wu, William D. Nix, Jang Wook Choi, Yi Cui, "Novel Size and Surface Oxide Effects in Silicon Nanowires as Lithium Battery Anodes", *Nano Letters*, 11, 4018-4025 (2011).
26. Ill Ryu, Jang Wook Choi, Yi Cui, William D. Nix, "Size-dependent fracture of Si nanowire battery anodes", *Journal of the Mechanics and Physics of Solids*, 59, 1717-1730 (2011), **Chosen as most cited paper in Journal of the Mechanics and Physics of Solids since 2009.**
27. Dongun Kim, Harsha Badarinarayan, Ill Ryu, Ji Hoon Kim, Chongmin Kim, Kazutaka Okamoto, R. H. Wagoner, Kwansoo Chung, "Numerical Simulation of Friction Stir Spot Welding Process for Aluminum Alloys", *Metals and Materials International*, 16, 323-332 (2010).
28. Dongun Kim, Harsha Badarinarayan, Ill Ryu, Ji Hoon Kim, Chongmin Kim, Kazutaka Okamoto, R. H. Wagoner, Kwansoo Chung, "Numerical Simulation of Friction Stir Spot Welding Process", *International Journal of Material Forming*, 2, 383-386 (2009).

## **Incoming Publications**

1. Guensik Min, Jeongseok Kim, Phu Cuong Nguyen, Sungmin Lee, Yeonju Oh, Simoon Sung, Hwangsun Kim, Hyoung Chan Kim, Ill Ryu and Heung Nam Han, “Elucidating the effect of potassium doping on the ductile-brittle transition temperature of tungsten” (*Submitted to International Journal of Plasticity*).
2. Nicole K. Aragon, Phu Cuong Nguyen, Hojun Lim, Ill Ryu, “Predicting dislocation plasticity of single crystalline Ta micropillars under the dynamic loading and high temperatures of Taylor impact testing” (*Submitted to International Journal of Plasticity*).
3. Phu Cuong Nguyen, Taejoon Park, Ill Ryu, “Dislocation plasticity in porous micropillars: effect of relative density, size, and shape of voids under uniaxial tension” (*Submitted to Extreme Mechanics Letter*).
4. Phu Cuong Nguyen, Ill Ryu, “Mechanical Properties of Nanolattices: A Dislocation Dynamics Study” (*Submitted to Acta Materialia*).
5. Phu Cuong Nguyen, Taejoon Park, Nicole Aragon, Farhang Pourboghraat, Ill Ryu, “Multiscale Modeling of Plasticity via Defect Dynamics Element Method” (*Submitted to Journal of the Mechanics and Physics of Solids*).

## **Selected Presentations**

1. Cuong P. Nguyen, Ill Ryu, “Defect-based damage model via a mesoscale defect dynamics modeling”, The minerals metals & materials society (TMS) meeting, San Diego, CA, USA (2024).
2. Cuong P. Nguyen, Ill Ryu, “Microscopic damage model via a meso-scale defect dynamics”, the international conference on Computational Plasticity, Barcelona, Spain (2023).
3. Cuong P. Nguyen, Ill Ryu, “Multi-scale Modeling of Dislocation Plasticity in Nano-architected Materials”, The 7th World Congress on Integrated Computational Materials Engineering (ICME 2023), Orlando, FL (2023).
4. Ill Ryu, “Multiscale Modeling of Defect Driven Plasticity”, Material Science and Engineering Department seminar, Seoul National University, Seoul, Korea (2023) **(Invited)**
5. Ill Ryu, “Defect-driven Plasticity in Nanostructured Metals - Defects make materials interesting”, Korea Institute of Science and Technology, KIST Jeonbuk, Korea (2023) **(Invited)**
6. Ill Ryu, Cuong P. Nguyen, Nicole Aragon, Hojun Lim, “Multiscale and Multiphysical Modeling of Defect Driven Plasticity and its Applications”, International Conference on Plasticity, Damage and Fracture, Punta Cana, Dominica Republic (2023) **(Key Note)**
7. Ill Ryu, “Multiscale Modeling of Defect Driven Plasticity”, Nuclear Engineering Department seminar, Kyung Hee University, Seoul, Korea, (2022) **(Invited)**
8. Cuong P. Nguyen, Ill Ryu, “Multi-scale Modeling of Dislocation Plasticity: Nanoporous Single-crystalline Metals”, The 10th International Conference on Multiscale Materials Modeling (MMM10), Baltimore, Maryland (2022).
9. Nicole Aragon, Cuong P. Nguyen, Hojun Lim, Ill Ryu, “BCC Ta single crystals during Taylor impact”, The 10th International Conference on Multiscale Materials Modeling (MMM10), Baltimore, Maryland (2022).
10. Ill Ryu, “Multiscale modeling of size-dependent plasticity at submicron-length scale”, Material Research Society (MRS) Spring meeting, Honolulu, Hawai'i (2022) **(Invited)**.
11. Cuong P. Nguyen, Nicole Aragon, Hojun Lim, Ill Ryu, “Defect Dynamics Models for Defect-Controlled Plasticity in Nanostructured Metals”, The Materials Science & Technology (MS&T) (MS&T), Pittsburgh, PA, (2022).
12. Ill Ryu, “Multiscale modeling of size-dependent plasticity at submicron-length scale”, Seminar, Posco Research Institute, Kwangyang, South Korea (2022) **(Invited)**.
13. Ill Ryu, “Defect-driven Plasticity in Nanostructural Metals”, International Conference on Electronic Materials and Nanotechnology for Green Environment (ENGE 2022), Jeju, South Korea (2022): **(Invited)**.
14. Ill Ryu, “Multiscale modeling of size-dependent plasticity at submicron-length scale”, Mechanical Engineering Department seminar, Hanyang University, Seoul, South Korea (2022) **(Invited)**.
15. Cuong P. Nguyen, Ill Ryu, “Multiscale modeling of size-dependent plasticity at submicron-length scale”, The 19<sup>th</sup> International Conference on the strength of materials (ICSMA19), Metz, France (2022).
16. Nicole Aragon, Jamie Gravell, and Ill Ryu, “Investigation of dislocation interactions in a bicrystalline micropillar through an atomistically-informed discrete dislocation dynamics model”, The minerals metals & materials society (TMS) meeting, San Diego, CA, USA (2020).

17. Cuong P. Nguyen, Ill Ryu, "Investigating the Mechanical Behavior of Nano-architected Materials via Multiscale Discrete Defect Element Method", The minerals metals & materials society (TMS) meeting, San Diego, CA, USA (2020).
18. Taejoon Park, Cuong P. Nguyen, Farhang Pourboghraat, Ill Ryu, "Multiscale model of small-scale plasticity via discrete defect element method", the International conference on Computational Plasticity, (2019).
19. Taejoon Park, Cuong P. Nguyen, Farhang Pourboghraat, Ill Ryu, "Probing defect-controlled plasticity at small scale via multiscale discrete defect element method", The minerals metals & materials society (TMS) meeting, San Antonio, TX, USA (2019).
20. Jamie Gravell, Junho Cho, Seungjoon Lee, Yannis Kevrekidis, Ill Ryu, "Predicting small scale plasticity in single-crystal micropillars via machine-learning approach", The minerals metals & materials society (TMS) meeting, San Antonio, TX, USA (2019).
21. Ill Ryu, "Investigating the mechanical behavior of nano-architected materials via multiscale discrete defect element method", Material Science and Engineering Department seminar, Texas A&M, College Station, TX (2019) (**Invited**).
22. Ill Ryu, "Probing defect-controlled plasticity at small scale via multiscale discrete defect element method", Aerospace Engineering Department seminar, UT Austin, Austin, TX (2019) (**Invited**).
23. Nicole Aragon, Sheng Yin, Huajian Gao, Ill Ryu, "Dislocation interaction with the grain boundary in bi-crystalline FCC micropillars", The 18<sup>th</sup> International Conference on the strength of materials (ICSMA18), The Ohio State University, Columbus OH (2018).
24. Nicole Aragon, Sheng Yin, Huajian Gao, Ill Ryu, "Temperature Effect on the Plasticity of BCC Micropillars", The minerals metals & materials society (TMS) meeting, Phoenix, USA (2018).
25. Jamie Gravell, Ill Ryu, "Effect of Twist Boundary Stability of Dislocation Network under Unloading", The minerals metals & materials society (TMS) meeting, Phoenix, USA (2018).
26. Ill Ryu, John Hutchinson, Huajian Gao, "Dislocation Dynamics Models of Strain Gradient Plasticity under Non-Proportional Loadings", Material Research Society (MRS) fall meeting, Boston, USA (2017).
27. Ill Ryu, "Size dependent mechanical behaviors in metal: Defect make materials interesting", Department of Integrated Systems Engineering Seminar, The Ohio State University, Columbus OH (2017) (**Invited**).
28. Nicole Aragon, Ill Ryu, "The role of dislocation source from dislocation nucleation at the grain boundary in bi-crystalline FCC micropillars", The Society of Engineering Science (SES) Technical Meeting, Northeastern University, Boston, MA (2017).
29. Jamie Gravell, Ill Ryu, "Three-dimensional dislocation dynamic simulations in tension and torsion loadings of single crystal Cu", The Society of Engineering Science (SES) Technical Meeting, Northeastern University, Boston, MA (2017).
30. Ill Ryu, John Hutchinson, Huajian Gao, "Microscopic investigation of strain gradient plasticity under non-proportional loading", Dislocations 2016, Purdue University, West Lafayette, IN (2016).
31. Ill Ryu, "Size dependent plasticity in metal micropillars", Department of Mechanical Science and Engineering Seminar, University of Illinois at Urbana-Champaign, IL(2016) (**Invited**).

32. Ill Ryu, David Srolovitz, Huajian Gao, "Modeling internal boundary and plasticity using dislocation dynamics", The Schöntal Symposium on Dislocation-based Plasticity, the monastery Bad Schöntal, Germany (2016) (**Invited**).
33. Ill Ryu, William D. Nix, Wei Cai, Huajian Gao, "Modeling plasticity of FCC/BCC micropillars under uniaxial loading using dislocation dynamics", The New England Workshop on the Mechanics of Materials and Structures, Boston University, Boston, USA (2015).
34. Ill Ryu, "Size dependent mechanical behaviors: defects make materials interesting", Department of Material Science and Engineering Seminar, Texas A&M University, College station, TX (2015) (**Invited**).
35. Ill Ryu, William D. Nix, Wei Cai, Huajian Gao, "Modeling plasticity of FCC/BCC micro-pillars under torsion using dislocation dynamics", The minerals metals & materials society (TMS) meeting, Orlando, USA (2015).
36. Ill Ryu, William D. Nix, Wei Cai, Huajian Gao, "Modeling plasticity of FCC/BCC micro-pillars under torsion using dislocation dynamics", Gordon Research Conference, Bentley University, MA, USA (2014): Poster presentation.
37. Ill Ryu, William D. Nix, Huajian Gao, "Size dependent plasticity in FCC micro-pillars: Source starvation and truncation ", Material Research Society (MRS) fall meeting, Boston, USA (2013).
38. Ill Ryu, Huajian Gao, "Modeling dislocation nucleation of FCC micro-pillars using dislocation dynamics", The New England Workshop on the Mechanics of Materials and Structures, Northeastern University, Boston, USA (2013).
39. Ill Ryu, Seokwoo Lee, Yi Cu, William D. Nix, "Fracture of Crystalline Si-NWs for Lithium-Ion Batteries", Society of Engineering and Science conference, Brown University, RI, USA (2013).
40. Ill Ryu, "Size Dependent Fracture and Plasticity in Nanostructures", Department of Material Science and Engineering Seminar, Seoul National University, Seoul, Korea (2013) (**Invited**).
41. Ill Ryu, Seokwoo Lee, Yi Cu, William D. Nix, "Microscopic model for Fracture of Crystalline Si-NWs for Li Ion Batteries", The 13th International Conference on Fracture, Beijing, China (2013) **Selected as Outstanding presentation on ICF13 as a young scientist**.
42. Ill Ryu, Christopher R. Weinberger, William D. Nix, Wei Cai, "Three-dimensional dislocation dynamic simulations in BCC metal micro-pillars", The minerals metals & materials society (TMS) meeting, Orlando, USA (2012).
43. Ill Ryu, Wei Cai, William D. Nix, "Three-dimensional dislocation dynamic simulations in BCC metal micro-pillars", Dislocations 2012, Budapest, Hungary (2012): Poster presentation.
44. Ill Ryu, William D. Nix, "Mechanics of Fracture of Crystalline Si-NWs for Lithium-Ion Batteries", Gordon Research Conference, Maine, USA (2012): Poster presentation.
45. Ill Ryu, William D. Nix, "Size dependent fracture of Si-NWs subjected to lithiation/ delithiation", The minerals metals & materials society (TMS) meeting, San Diego, USA (2011).
46. Ill Ryu, William D. Nix, "Numerical study of fracture of Si-NWs subjected to lithiation/ delithiation", Gordon Research Conference, Maine, USA (2010): Poster presentation.

## **Teaching Experience**

### **Seoul National University** (Seoul, Korea)

- Instructor, Title of course: Introduction to Mechanics of Materials (Undergraduate), Imperfections in Crystalline Solids (Undergraduate), Fracture Mechanics (Graduate)

### **University of Texas at Dallas** (Richardson, TX)

- Instructor, Title of course: Introduction to Material Science (Undergraduate), Mechanics of Materials (Undergraduate), Intermediate Mechanics of Materials (Undergraduate), Imperfections in Solids (Graduate), Fracture Mechanics (Graduate)

### **Brown University** (Providence, RI)

- Instructor, Title of course: Advanced Engineering Mechanics (Spring 2016)

### **Stanford University** (Palo Alto, CA)

- Teaching Assistant and guest Lecturer for graduate courses
- Title of courses: Mechanical Properties of Thin Films (Winter 2013), Statistical Mechanics (Winter 2011), Microstructure and Mechanical Properties (Fall 2011), Imperfections in Crystalline Materials (Spring 2010)

### **Seoul National University** (Seoul, Korea)

- Teaching Assistant and guest Lecturer for undergraduate courses  
Title of courses: Engineering Mathematics (Fall 2005), Mechanics in Materials (Spring 2005)

### **Barrington Christian Academy-** (RI, USA)

- High school teacher for AP Calculus, AP Chemistry (Fall 2014~ Spring 2016)

## **Society Memberships and Editorial and Professional Activities**

- Membership in **MRS** (Material Research Society), **TMS** (The Minerals, Metals and Material Society) and **SES** (Society of Engineering Science)
- ICME (Integrated Computational Materials Engineering) committee member in **TMS**
- Journal peer review activities: Journal of the Mechanics and Physics of Solids, International Journal of Solids and Structures, Acta Materialia, Scripta Materialia, Nano Letters, Proceedings of the royal society A
- Conference session chair
  - Advances in Computational Methods for Damage Mechanics and Failure Phenomena: Crystal Plasticity Methods II, TMS meeting, San Antonio, TX (2019)
  - Effects of Grain Boundaries and Interfaces I, ICSMA meeting, Columbus, OH (2018)
  - Dynamic Probing of Microstructure Evolution in Nanostructured Materials — Size Effect and Fracture/Fatigue Studies, TMS meeting, Orlando, FL (2015)
  - Lithium ion batteries: When Chemistry meets Mechanics, Society of Engineering and Science conference, Brown University, Providence, RI (2013)