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Research Interests

Atomic-scale characterization of low-dimensional heterostructure under extreme conditions

- Exploring structural, electrical, magnetic, and thermal properties of low dimensional heterostructure to establish structure-property relationships with atomic resolution. Exploiting scanning tunneling microscopy and spectroscopy (STM/S) and atomic force microscopy (AFM) to characterize physical properties of local heterogeneities in ultra-high vacuum (UHV), ultra-low temperature (40 mK), and vector magnetic field (2-2-9 T) conditions.

Seamless connection between atomic-level probing and atomistic synthesis of van der Waals (*vdW*) materials

- Construction of universal metal-organic chemical vapor deposition (MOCVD) cluster with UHV transfer system. Securing atomic level surface cleanliness after MOCVD growth with vacuum transfer to preserve atomically synthesized heterogeneities in *vdW* materials, such as atomic impurities, hetero-interface, Moiré super lattice, etc. Development of accurate probe positioning with atomic precision at the targeted heterogeneity to observe controlled functionality.

Statistical analysis for multi-dimensional dataset

- To accelerate data analysis, deploying data handling python package for characterization and visualization of material functionality on the atomic scale. To analyze inherently multi-dimensional STM/S and AFM datasets, utilizing advanced statistical toolkits, such as machine learning and image processing techniques.

Research Experience

- 2023.03– present millikelvin R&D Staff, Scanning Tunneling Microscopy Group, CNMS, ORNL
- 2022.02– 2023.02 Senior Research Fellow, IBS, Center for Van der Waals Quantum Solid, Korea (South)
- 2020.05–2022.02 Senior Research Fellow, IBS, Center for Artificial Low Dimensional Electronic Systems, Material group, Korea (South)
- 2016.11–2020.05 Faculty of IBS, IBS, CALDES, Physics group, Korea (South)
- 2012.10–2016.09 Postdoctoral Research Associate, Center for Nanophase Materials Sciences (CNMS), Oak Ridge National Laboratory (ORNL), United States
- 2012.05–2012.09 Research Fellow, Center for Low Dimensional Electronic Symmetry, Pohang University of Science and Technology (POSTECH), Korea (South)
- 2010.09–2012.05 Post-doctoral Research Associate, Center for Atomic Wires and Layers, POSTECH, Korea (South)

Education

- 2003.03–2010.08 Ph. D. in Physics, Seoul National University (SNU) (Advisor: Prof. Kookrin Char)
- 2001.03–2003.02 M. S. in Physics, SNU, Seoul, Korea (South)
- 1997.03–2001.02 B. S. in Physics, SNU, Seoul, Korea (South)

Publications

(h-index: 12, total citation: 1238)

1. H.S. Lee, G.H. Moon, S.H. Lee, J. Park*, & M.-H. Jo*, "One-dimensional conduction in mirror twin boundary of MoS_2 manipulated by vicinal sapphire substrates" (*to be submitted*)
2. J. H. Kim, K.H. Jin, Y. Jung, M.-H. Jo, G.-H. Lee, & J. Park*, "Manipulation of interlayer coupling in epitaxial few-layer MoS_2" (*to be submitted*)
3. H.K. Kim, S.M. Song, T.M. Anh, T.H. Kim, & J. Park*, "Extrapolation of quasi-particle interference spectroscopy using convolutional neural network" (*to be submitted*)
4. O. F. N. Okello, D.-H. Yang, S.-Y. Seo, J.Park, G. Moon, D. Shin, Y.-S. Chu, S. Yang, T. Mizoguchi, M.-H. Jo and Si-Young Choi, Atomistic probing of defect-engineered 2H-$MoTe_2$ monolayers, ACS Nano, **18**, 6927 (2024)
5. S.-Y. Seo, G. Moon, O. F. N. Okello, M. Y. Park, C. Han, S. Cha, H. Choi, H. W. Yeom, S.-Y. Choi, **J. Park**, & M.-H. Jo, "Reconfigurable photo-induced doping of two-dimensional van der Waals semiconductors using different photon energies", *Nat. Electron.* **4**, 38 (2021)
6. N. Kim, S.Choi, S.-J. Yang, **J. Park**, J.-H. Park, N. N. Nguyen, K. Park, S. Ryu, K. Cho, & C.-J. Kim, "Graphene Nanoribbon Grids of Sub-10 nm Widths with High Electrical Connectivity", ACS Appl. Mater. Interfaces **13**, 24, 28593 (2021)
7. J. Gao,J. W. Park, K. Kim, S. K. Song, H. R. Park, J. Lee, **J. Park**, F. Chen, X. Luo, Y. Sun, & H. W. Yeom, "Pseudogap and weak multifractality in 2D disordered Mott charge-density-wave insulator", *Nano Lett.* **20**, 6299 (2020)
8. **J. Park**, F. Lüpke, J. Jiang, X.-G. Zhang, & A.-P. Li, "Spin-dependent thermoelectric power of nanoislands", *Nano Lett.* **20**, 4910 (2020)
9. J. Kim, T.-S. Ju, S. Song, D. Lee, S. Y. Cho, S. D. Bu, W. Ko, A.-P. Li, **J. Park***, & S. Park*, "Enhancing the local conductivity of Cu films using temperature-assisted agglomerated Cu nanostructures", J. Phys. D: Appl. Phys. **53** 09LT02 (2019)
10. S.-Y. Seo, J. Park, **J. Park**, K. Song, s. Char, S. Sim, S.-Y. Choi, H. W. Yeom, H. Choi, & M.-H. Jo, "Programmable writing of integrated circuits on a two-dimensional transition-metal dichalcogenide", *Nat. Electron.* **1**, 512 (2018)
11. G. D. Nguyen, J. Lee, T. Berlijn, Q. Zou, S. M. Hus, **J. Park**, Z. Gai, C. Lee, & A.-P. Li, "Visualization and manipulation of magnetic domains in the quasi-two-dimensional material Fe_3GeTe_2", *Phys. Rev. B* **97**, 014425 (2018)
12. H. Zhang, X. Li, Y. Chen, **J. Park**, A.-P. Li, & X.-G. Zhang, "Post processing Algorithm for Driving Conventional Scanning Tunneling Microscope at Fast Scan Rates", *Scanning*, vol. 2017, Article ID 1097142 (2017)
13. **J. Park**, C. Park, M. Yoon, & A.-P. Li, "Surface magnetism of cobalt nanoislands controlled by atomic hydrogen", *Nano Lett.***17**, 292 (2017)

14. C. Ma, **J. Park**, L. Liu, A. P. Baddorf, G. Gu, & A.-P. Li, "Interplay between intercalated oxygen superstructures and monolayer h-BN on Cu(100)", *Phys. Rev. B* **94**, 064106 (2016)
15. I. Soykal, H. Wang, **J. Park**, A.-P. Li, C. Liang, & V. Schwartz, "Highly dispersed buckybowls as model carbocatalysts for C–H bond activation", *J. Mater. Chem. A*, Advance Article, (2015)
16. **J. Park***, J. Lee*, L. Liu, C. Durand, C. Park, M. Yoon, B. G. Sumpter, A. P. Baddorf, G. Gu, & A.-P. Li, "Spatially resolved one-dimensional boundary states in graphene-hexagonal boron nitride planar heterostructures", *Nat. Commun.* **5**, 5403(2014) (*these authors contributed equally to this work)
17. L. Liu*, **J. Park***, D. A. Siegel, K. F. McCarty, K. W. Clark, W. Deng, L. Basile, J. C. Idrobo, A.-P. Li, & G. Gu, "Heteroepitaxial growth of two-dimensional hexagonal boron nitride templated by graphene edges", *Science* **343**, 163 (2014) (*these authors contributed equally to this work, cited > 480 times)
18. K. W. Clark, X.-G. Zhang, G. Gu, **J. Park**, G. He, R. M. Feenstra, & A.-P. Li, "Energy gap induced by Friedel oscillations manifested as transport asymmetry at monolayer-bilayer graphene boundaries", *Phys. Rev. X* **4**, 011021 (2014)
19. **J. Park**, K. Nakatsuji, T.-H. Kim, S. K. Song, F. Komori, and H. W. Yeom, "Absence of the Luttinger liquid behavior in Au-Ge wires: a high-resolution scanning tunneling microscopy and spectroscopy study", *Phys. Rev. B* **90**, 165410 (2014)
20. **J. Park**, G. He, R. M. Feenstra, & A.-P. Li, "Atomic-scale mapping of thermoelectric power on graphene: role of defects and boundaries", *Nano Lett.* **13**, 3269 (2013) highlighted by Nature Nanotechnology (2013)
21. **J. Park**, S. W. Jung, M.-C. Jung, H. Yamane, N. Kosugi, & H. W. Yeom, "Self-assembled nanowires with giant Rashba split bands", *Phys. Rev. Lett.* **110**, 036801 (2013)
22. **J. Park**, S. Khim, G. S. Jeon, J. S. Kim, K. H. Kim, and K. Char, "Direct observation of two-gap superconductivity in $SrFe_{1.85}Co_{0.15}As_2$ single crystals by scanning tunneling microscopy and spectroscopy", *New J. Phys.* **13**, 033005 (2011)
23. **J. Park**, S. Hyun, A. Kim, T. Kim, & K. Char, "Observation of biological samples using a scanning microwave microscope", *Ultramicroscopy* **102**, 101 (2005)
24. J. Lee, **J. Park**, A. Kim, K. Char, S. Park, N. Hur, & S.-W. Cheong, "Phase separation in $La_{5/8}Sr_{3/8}MnO_3$(30%) + $LuMnO_3$(70%) bulk sample studied by scanning microwave microscopy", *Appl. Phys. Lett.* **86**, 012502 (2005)
25. Y.-S. Shin, H.-J. Lee, J. Kim, **J. Park**, & K. Char, "Magnetic domain configuration in cobalt and permalloy micro-structure", *J. Korean Phys. Soc.* **44**, 904 (2004)
26. T.A. Pham, J.W. Park, D. K. Bhoi, K. H. Kim, H. W. Yeom, C. Park, & J. Park*, "Role of Pd intercalation in charge density wave states of 2H-$TaSe_2$", (in preparation)
27. J. Park, S. Jeon, G. Kim, J.-G. Lee, and J. Park*, "Local charge ordering near intrinsic defects in 2H–$MoTe_2$", (in preparation)

Professional Memberships

- 2001 – p Member, Korean Physical Society
- 2002 – p Member, American Physical Society
- 2013 – p Member, American Vacuum Society
- 2017 – p Member, Korean Vacuum Society
- 2018 – p Member, Korean Ceramic Society
- 2019 – p Member, Korean Superconductivity Society

Presentations

(Invited Talks)

1. "Spin-dependent Thermoelectric Power of Co Nano-islands", 16th United Symposium for Dielectric Materials, Busan, Korea, 2021
2. "Spin-dependent Thermoelectric Power of Nano-islands" International Workshop on Scanning Probe Microscopy (IWSPM), Pohang, Korea, 2020
3. "Coexistence of Charge Density Wave and Superconductivity in Pd Intercalated 2H-$TaSe_2$ Single crystal", Korea Institute of Superconductivity and Cryogenics, Yongpyoung, Korea, 2019
4. "Probing Spin-dependent Seebeck effect with Spin-polarized Scanning Tunneling Thermovoltage Microscopy", Daejeon, Korea, 2019
5. "Role of Hydrogen in Controlling Spin-polarized Surface States of Nano-islands", *Korean Ceramic Society*, IBS and RIKEN conference, Seoul, Korea, 2018
6. "Controlling Surface Magnetism of Co Nano-islands on Cu(111) with Atomic Hydrogen", *ACSIN-14 & ICSPM26*, Sendai, Japan, 2018
7. "Probing Electric Properties of Hetero-interface at Graphene/Hexagonal Boron Nitride In-plane Junction", *East Asia Microscopy Conference*, Korea, 2017
8. "Atomically Resolved Thermoelectric Power of Graphene using Scanning Thermovoltage Microscopy ($SV_{th}M$)", *The 2nd International symposium: Recent Trends in Analysis Techniques for Functional Materials and Devices*, Osaka, Japan, 2017
9. "Probing Electric Properties at the Boundary of Planar 2D Heterostructure", *American Physical Society March Meeting*, Baltimore, MD, USA, 2016

(Contributed Talks)

10. "STM Study of the correlation between structural, magnetic, and electronic properties of Co nano-islands on Cu(111)", J. Park, C. Park, M. Yoon, Z. Gai, A.P. Baddorf, and A.-P. Li, *AVS 62nd International Symposium and Exhibition*, San Jose, CA, USA, 2014
11. "Spatially-resolved one-dimensional interfacial states formed by two-dimensional heteroepitaxy", J. Park, *Korean Physics Society Spring Meeting*, Daejeon, Korea, 2014
12. "Two-dimensional heteroepitaxial growth of hexagonal boron nitride from graphene edges", J. Park, L. Liu, D. A. Siegel, K. F. McCarty, K. W. Clark, W. Deng, L. Basile, J. C. Idrobo, A.-P. Li, and G. Gu, *The 7th Workshop for Emergent Materials Research*, Pohang, Korea, 2014
13. "Coherent one dimensional boundaries in graphene and hexagonal boron nitride heterostructures", J. Park, L. Liu, K. W. Clark, W. Deng, D. A. Siegel, K. F. McCarty, G. Gu, and A.-P. Li, *AVS 61st International Symposium and Exhibition*, Baltimore, MD, USA, 2014
14. "Heterostructures formed by epitaxial growth of two-dimensional hexagonal boron nitride from graphene edges", J. Park, L. Liu, D. A. Siegel, K. F. M., K. W. Clark, W. Deng, L. Basile, J. C. Idrobo, A.-P. Li, and G. Gu, *The 2014 International Conference on Nanoscience + Technology (ICN+T)*, Vail, CO, USA, 2014
15. "Spatially-resolved thermopower of graphene: role of boundary and defects", J. Park, G. He, R. M. Feenstra, and A.-P. Li, *American Physical Society March Meeting*, Denver, CO, USA, 2014
16. "STM mapping of thermoelectric power on graphene across defects and boundaries", J. Park, G. He, R. M. Feenstra, and A.-P. Li, *AVS 60th International Symposium and Exhibition*, Long Beach, CA, USA, 2013

17. "Giant Rashba spin splitting found on Pt-induced nanowire", J. Park, S. W. Jung, M.-C. Jung, H. Yamane, N. Kosugi, and H. W. Yeom, *International Conference on Nanoscience + Technology (ICN+T)*, Paris, France, 2012
18. "Giant Rashba spin-splitting found on self-assembled nanowire", J. Park, S. W. Jung, M.-C. Jung, H. Yamane, N. Kosugi, and H. W. Yeom, *Korean Physics Society Spring Meeting*, Daejeon, Korea, 2012
19. "Direct observation of two-gap superconductivity in $SrFe_{1.85}Co_{0.15}As_2$ single crystals by scanning tunneling microscopy and spectroscopy", J. Park, S. Khim, G. S. Jeon, J. S. Kim, K. H. Kim, and K. Char, *American Physical Society March Meeting*, Portland, OR,USA, 2010
20. "Investigation of tunneling density of state of FSF trilayers", J. H. Kwon, J. Park, S. K. Choi, K.Char, P. G. Sangiorgio, and M. R. Beasley, *American Physical Society March Meeting*, Denver, CO, USA, 2007
21. "Investigation of ferroelectric materials with scanning microwave microscope", J. Park, J. H. Cho, S. Lee, and K. Char, *American Physical Society March Meeting*, Baltimore, MD, USA, 2006
22. "Surface-following scanning for dielectric samples in a scanning microwave microscopy", J. Park, A. Kim, J. Lee, J. H. Kong, and K. Char, *Korean Physics Society Fall Meeting*, Jeju, Korea, 2004
23. "Observation of biological samples by scanning microwave microscopy (SMM)" J. Park, S. Hyun, A. Kim, T. Kim, and K. Char, *American Physical Society March Meeting*, Indianapolis, IN, USA, 2002