

## Experience

### Fermi National Accelerator Laboratory (FNAL).

2023–Present *Deputy Head*, Qubits and Materials department, SQMS division

2023–Present *Group Leader*, Materials for Quantum Devices group, Qubits and Materials department, SQMS division

2022–Present *Associate Scientist*

- Supervises group of 6 researchers working on identifying loss mechanisms in superconducting qubits and superconducting radio-frequency cavities through advanced materials characterization techniques
- Coordinated systematic study that eliminated a major source of performance degradation in superconducting qubits as part of a 15 person team

2021–2022 *Postdoctoral Research Associate*

- Investigated the role of two level systems in quantum devices using advanced microscopy techniques
- Acquired an understanding of chemical constituents present at interfaces in quantum systems through surface spectroscopy and spectrometry methods
- Collaborated with scientists at FNAL, Northwestern University, Ames Laboratory, and Rigetti Computing within the Superconducting Quantum Materials and Systems (SQMS) Center, as part of the National Quantum Initiative, to advance understanding of loss mechanisms in superconducting qubits

### ASM America.

2020–2021 *Senior Process Engineer*

- Designed and conducted a variety of process engineering experiments centered around atomic layer deposition of high-K dielectric thin films
- Analyzed data and generated internal and external technical reports to address challenging engineering problems that customers were facing

## Education

2015–2020 **PhD Materials Science and Engineering,**

*Northwestern University*, Evanston, IL.

Thesis: "Probing static and dynamic phenomena in two-dimensionally confined systems"

Certificate: Management for Scientists and Engineers, *Kellogg School of Management*

Advisor: Professor Vinayak P. Dravid

2012–2015 **BS Materials Science and Engineering,**

*University of Illinois at Urbana-Champaign*, Champaign, IL.

## Publications (39 Published Peer-Reviewed Articles)

- 2024 Bal, M.\*; **Murthy, A. A.\***; Zhu, S.\*; Crisa, F.\*;...Romanenko, A., Grassellino, A., Systematic Improvements in Transmon Qubit Coherence Enabled by Niobium Surface Encapsulation. *npj Quantum*, 10 (1) **2024**, 43.
- 2024 Bafia, D.; **Murthy, A. A.**; Grassellino, A.; Romanenko, A., Oxygen Vacancies in Niobium Pentoxide as a Source of Two-Level System Losses in Superconducting Niobium. *Phys. Rev. App.* 22 (2), **2024**, 024035.
- 2024 Oh, J.-S.; Zaman, R.; **Murthy, A. A.**; Bal, M.; Crisa, F.; Zhu, S.; Torres-Castanedo, C. G.; Kopas, C. J.; Mutus, J. Y.; Jing, D.; Zasadzinski, J.; Grassellino, A.; Romanenko, A.; Hersam, M. C.; Bedzyk, M. J.; Kramer, M. J.; Zhou, B.-C.; Zhou, L., Structure and Formation Mechanisms in Tantalum and Niobium Oxides in Superconducting Quantum Circuits. *ACS Nano*, 18 (30) **2024**, 19732-19741.
- 2024 Abdisatov, B.; Bafia, D.; **Murthy, A. A.**; Ereemeev, G.; Elsayed-Ali, H. E.; Lee, J.; Netepenko, A.; Carlos, C. P. A.; Leith, S.; Rosaz, G. J.; Romanenko, A.; Grassellino, A., Direct Measurement of Microwave Loss in Nb Films for Superconducting Qubits. *App. Phys. Lett.* 125 (12), **2024**, 124002.

- 2024 Oh, J.-S.; Kopas, C. J.; Marshall, J.; Fang, X.; Joshi, K. R.; Datta, A.; Ghimire, S.; Park, J.-M.; Kim, R.; Setiawan, D.; Lachman, E.; Mutus, J. Y.; **Murthy, A. A.**; Grassellino, A.; Romanenko, A.; Zasadzinski, J.; Wang, J.; Prozorov, R.; Yadavalli, K.; Kramer, M. J.; Zhou, L., Exploring the Relationship between Deposition Method, Microstructure, and Performance of Nb/Si-based Superconducting Coplanar Waveguide Resonators. *Acta Mater.*, **2024**.
- 2024 Sung, Z. H.; Cano, A.; **Murthy, A. A.**; Karapetrova, E.; Lee, J.; Martinello, M.; Grassellino, A.; Romanenko, A., First Direct Observation of Nanometer Size Hydride Precipitations on Superconducting Niobium. *Sci. Reports*, 14 (1), **2024**, 26916.
- 2024 Kopas, C. J.; Goronzy D. P.; Pham, T.; Torres Castanedo, C. G.; Cheng, M.; Cochrane, R.; Nast, P.; Lachman, E.; Zhelev, N. Z.; Vallières, A.; **Murthy, A. A.**; Oh, J.-S.; Zhou, L.; Kramer, M. J.; Cansizoglu, H.; Bedzyk, M. J.; Dravid, V. P.; Romanenko, A.; Grassellino, A.; Mutus, J. Y.; Hersam M. C.; Yadavalli, K.; Enhanced Superconducting Qubit Performance through Ammonium Fluoride etch. *Mater. Quantum Technol.*, 4, **2024**, 045101.
- 2024 Zhu, S.; You, X.; Alyanak, U.; Bal, M.; Crisa, F.; Garattoni, S.; Lunin, A.; Pilipenko, R.; **Murthy, A. A.**; Romanenko, A.; Grassellino, A., Disentangling the Impact of Quasiparticles and Two-Level Systems on the Statistics of Superconducting Qubit Lifetime. arXiv preprint arXiv:2409.09926.
- 2023 Krasnikova, Y.; **Murthy, A. A.**; Crisa, F.; Bal, M.; Sung, Z. H.; Lee, J.; Cano, A.; van Zanten, D. M.; Romanenko, A.; Grassellino, A.; Suter, A.; Prokscha, T.; Salman, Z., Magnetic Fluctuations in Niobium Pentoxide. arXiv preprint arXiv:2312.10697.
- 2023 Lee, J.\*; Sitaraman N. S.\*; Sung, Z.; Arias, T. A.; **Murthy, A. A.**; Grassellino, A.; Romanenko, A., Stress-induced structural changes in superconducting Nb thin films. *Phys. Rev. Mater.*, 7 (6), **2023**, L063201.
- 2023 Li, S.; Ouyang, D.; Zhang, N.; Zhang, Y.; **Murthy, A. A.**; Li, Y.; Liu, S.; Zhai, T., Substrate Engineering for Chemical Vapor Deposition Growth of Large-Scale Two-Dimensional Transition Metal Dichalcogenides. *Adv. Mater.*, 34, **2023**, 2211855.
- 2023 He, X.; Deng, Y.; Ouyang, D.; Zhang, N.; Wang, J.; **Murthy, A. A.**; Spanopoulos, I.; Islam, S. M.; Tu, Q.; Xing, G.; Li, Y.; Dravid, V. P.; Zhai, T., Recent Development of Halide Perovskite Materials and Devices for Ionizing Radiation Detection. *Chem. Rev.*, 23 (4), **2023**, 1207-1261.
- 2023 Palacios, E.; Sumant, A. V.; **Murthy, A. A.**; Dereshgi, S. A.; Dravid, V. P.; Aydin, K., Unveiling Coupled Anapole Modes in Ultrananocrystalline Diamond. *ACS Appl. Opt. Mater.*, 10 (1), **2023**, 1627-1633.
- 2023 Mazzio, K. A.; Sengupta, I.; **Murthy, A. A.**; Hood, Z. D.; Lutz, D. M.; Anasori, B., Critical Parameters in the Faculty Application Process: A Data-Driven Analysis. *MRS Bull.*, 48 (7), **2023**, 791-798.
- 2022 **Murthy, A. A.**; Das, P. M.; Ribet, S. M.; Kopas, C.; Lee, J.; Reagor, M. J.; Zhou, L.; Kramer, M. J.; Hersam, M. C.; Checchin, M.; Grassellino, A.; dos Reis, R.; Dravid, V. P.; Romanenko, A., Developing a Chemical and Structural Understanding of the Surface Oxide in a Niobium Superconducting Qubit. *ACS Nano*, 16 (10), **2022**, 17257-17262.
- 2022 **Murthy, A. A.**; Lee, J.; Kopas, C.; Reagor, M. J.; McFadden, A. P.; Pappas, D. P.; Checchin, M.; Grassellino, A.; Romanenko, A., TOF-SIMS Analysis of Decoherence Sources in Superconducting Qubits. *App. Phys. Lett.* 120 (4), **2022**, 044002.
- 2022 Stanev, T. K.; Liu, P.; Zeng, H.; Lenferink, E. J.; **Murthy, A. A.**; Speiser, N.; Watanabe, K.; Taniguchi, T.; Dravid, V. P.; Stern, N. P., Direct Patterning of Optoelectronic Nanostructures using Encapsulated Layered Transition Metal Dichalcogenides. *ACS App. Mater. Interfaces*, 14 (20), **2022**, 23775-23784.
- 2022 Zhu, S.; Crisa, F.; Bal, M.; **Murthy, A. A.**; Lee, J.; Sung, Z. H.; Lunin, A.; Frolov, D.; Pilipenko, D.; Bafia, D.; Mitra, A.; Romanenko, A.; Grassellino, A., High Quality Superconducting Nb Co-planar Resonators on Sapphire Substrate. arXiv preprint arXiv:2207.13024.
- 2022 Alam, M. S.; Belomestnykh, S.; Bornman, N.;... **Murthy, A. A.**; ... Zorzetti, S., Quantum Computing Hardware for HEP Algorithms and Sensing. arXiv preprint arXiv:2204.08605.
- 2021 Lee, J. Y.; Sung, Z; **Murthy, A. A.**; Reagor, M; Grassellino, A.; Romanenko, A., Discovery of Nb Hydride Precipitates in Superconducting Qubits. arXiv preprint arXiv:2108.10385.
- 2021 **Murthy, A. A.\***; Ribet, S. M.\*; Roth, E. W.; dos Reis, R.; Dravid, V. P., Imaging Hard-Soft Interfaces in Low-Dimensional Nanocomposites with Electron Microscopy. [invited review - *Materials Today*] 50, **2021**, 100-115.

- 2021 **Murthy, A. A.**; Stanev, T. K.; Ribet, S. M.; Watanabe, K.; Taniguchi, T.; Stern, N. P.; dos Reis, R.; Dravid, V. P., Spatial Mapping of Electrostatic Fields across 2D Heterostructures. *Nano Lett.* 21 (17), **2021**, 7131-7137.
- 2021 Amsterdam, S. H.; Stanev, T. K.; Wang, L.; Zhou, Q.; Irgen-Giorgio, S.; Padgaonkar, S.; **Murthy, A. A.**; Sangwan, V. K.; Dravid, V.P.; Weiss, E. A.; Darancet, P.; Chan, M. K. Y.; Hersam, M. C.; Stern, N. P.; Marks, T. J., Mechanistic Investigation of Molybdenum Disulfide Defect Photoluminescence Quenching by Adsorbed Metallophthalocyanines. *J. Am. Chem. Soc.* 143 (41), **2021**, 17153-17161.
- 2021 Dereshgi, S. A.; Larciprete, M. C.; Centini, M.; **Murthy, A. A.**; Tang, K.; Wu, J.; Dravid, V. P.; Aydin, K., Tuning of Optical Phonons in  $\alpha$ -MoO<sub>3</sub>-VO<sub>2</sub> Multilayers *ACS App. Mater. Interfaces*, 13 (41), **2021**, 48981-48987.
- 2021 LaMountain, T.; Nelson, J.; Lenferink, E. J.; Amsterdam, S. H.; **Murthy, A. A.**; Marks, T. J.; Dravid, V.P.; Hersam, M. C.; Stern, N. P., Valley-selective Optical Stark Effect of Exciton-Polaritons in a Monolayer Semiconductor. *Nat. Commun.* 12 (1), **2021**, 1-7.
- 2021 DiStefano, J. G.; **Murthy, A. A.**; Lescott, C. J.; dos Reis, R.; Li, Y.; Dravid, V.P., Structural Defects in Transition Metal Dichalcogenide Core-Shell Architectures. *App. Phys. Lett.* 118 (22), **2021**, 223103.
- 2020 DiStefano, J. G.; **Murthy, A. A.**; Hao, S.; dos Reis, R.; Wolverton, C.; Dravid, V.P., Au@MoS<sub>2</sub>@WS<sub>2</sub> Topology of Transition Metal Dichalcogenides: The Case of the Core-Shell Architecture.[invited review - *Nanoscale*] 12 (47), **2020**, 23897-23919.
- 2020 **Murthy, A. A.**; Stanev, T. K.; dos Reis, R.; Hao, S.; Wolverton, C.; Stern, N. P.; Dravid, V. P., Direct Visualization of Electric Field induced Structural Dynamics in Monolayer Transition Metal Dichalcogenides. *ACS Nano*, 14 (2), **2020**, 1569-1576.
- 2020 DiStefano, J. G.; **Murthy, A. A.**; Lescott, C. J.; dos Reis, R.; Li, Y.; Dravid, V.P., Au@MoS<sub>2</sub>@WS<sub>2</sub> Core-Shell Architectures: Combining Vapor Phase and Solution-Based Approaches. *J. Phys. Chem. C* 124 (4), **2020**, 2627-2633.
- 2020 Dereshgi, S. A.; Folland, T. G.; **Murthy, A. A.**; Song, X.; Tanriover, I.; Dravid, V. P.; Caldwell, J. D.; Aydin, K., Lithography-Free, Planar IR Polarization Filters and Converters via Biaxial Phonons in  $\alpha$ -MoO<sub>3</sub> Flakes Integrated into Fabry-Perot Cavities *Nat. Commun.*, 11 (1), **2020**, 1-9.
- 2020 Wei, C.; Dereshgi, S. A.; Song, X.; **Murthy, A. A.**; Dravid, V. P.; Aydin, K.; Cao, T., Polarization Reflector/Color Filter at Visible Frequencies via Anisotropic  $\alpha$ -MoO<sub>3</sub>. *Adv. Opt. Mater.*, **2020**, 2000088.
- 2019 Li, Y.; **Murthy, A. A.**; DiStefano, J. G.; Jung, H. J.; Palacios, E.; Hao, S.; Wolverton, C.; Aydin, K.; Chen, X.; Dravid, V.P., MoS<sub>2</sub>-capped Cu<sub>x</sub>S Nanocrystals: A New Route for Broadband Photodetection with Transition Metal Dichalcogenides. *Mater. Horiz.* 6 (3), **2019**, 587-594.
- 2019 **Murthy, A. A.\***; Yasaei, P.\*; Xu, Y.; dos Reis, R.; Shekhawat, G. S.; Dravid, V. P., Spatial Mapping of Hot-Spots across Interfaces in Monolayer Transition Metal Dichalcogenides. *Adv. Mater.*, **2019**, 31, 1808244.
- 2018 Li, Y.; Moy, E. C.; **Murthy, A. A.**; Hao, S.; Cain, J. D.; Hanson, E. D.; DiStefano, J. G.; Chae, W. H.; Li, Q.; Wolverton, C.; Chen, X.; Dravid, V. P., Large-Scale Fabrication of Multilayer MoS<sub>2</sub> Ribbons and Their Thermal Conductivity Study via Temperature-Dependent Raman spectroscopy. *Adv. Funct. Mater.* 28 (13), **2018**, 1704863.
- 2018 **Murthy, A. A.**; Stanev, T. K.; Cain, J. D.; Hao, S.; Wolverton, C.; Stern, N. P.; Dravid, V. P., Intrinsic Transport in 2D Heterostructures Mediated through h-BN Tunneling Contacts. *Nano Lett.* 18 (5), **2018**, 2990-2998.
- 2018 **Murthy, A. A.\***; Li, Y.\*; Palacios, E.; Li, Q.; Hao, S.; Wolverton, C.; Aydin, K.; Chen, X.; Dravid, V.P., Optically Active 1D MoS<sub>2</sub> Nano-belts. *ACS App. Mater. Interfaces*. 10 (8), **2018**, 6799-6804.
- 2018 Li, Y.; Hao, S.; DiStefano, J. G.; **Murthy, A. A.**; Hanson, E. D.; Xu, Y.; Wolverton, C.; Chen, X.; Dravid, V.P., Site-Specific Positioning and Patterning of MoS<sub>2</sub> Monolayers - The Role of Au Seeding. *ACS Nano* 12 (9), **2018**, 8970-8976.
- 2018 Li, Y.; Majewski, M. B.; Islam, S. M.; **Murthy, A. A.**; DiStefano, J. G.; Hanson, E. D.; Li, Q.; Kanatzidis, M. G.; Wasielewski, M. R.; Chen, X.; Dravid, V. P., Morphological Engineering of Winged Au@MoS<sub>2</sub> Heterostructures for Electrocatalytic Hydrogen Evolution. *Nano Lett.* 18 (11), **2018**, 7104-7110.

- 2018 DiStefano, J. G.; Li, Y.; Jung, H. J.; Hao, S.; **Murthy, A. A.**; Zhang, X.; Wolverton, C.; Dravid, V.P., Nanoparticle@MoS<sub>2</sub> Core-Shell Architecture: Role of the Core Material. *Chem. Mater.* 30 (14), **2018**, 4675-4682.
- 2018 Islam, S. M., Sangwan, V. K., Li, Y., Kang, J., Zhang, X., He, Y., Zhao, J., **Murthy, A. A.**, Ma, S., Dravid, V. P., Hersam, M. C., Kanatzidis, M. G., Abrupt Thermal Shock of (NH<sub>4</sub>)<sub>2</sub>Mo<sub>3</sub>S<sub>13</sub> Leads to Ultrafast Synthesis of Porous Ensembles of MoS<sub>2</sub> Nanocrystals for High Gain Photodetectors. *ACS App. Mater. Interfaces* 10 (44), **2018**, 38193-38200.
- 2017 Chae, W. H.; Cain, J. D.; Hanson, E. D.; **Murthy, A. A.**; Dravid, V. P., Substrate-Induced Strain and Charge Doping in CVD-Grown Monolayer MoS<sub>2</sub>. *App. Phys. Lett.* 111 (14) **2017**: 143106.
- 2017 Li, Y.; DiStefano, J. G.; **Murthy, A. A.**; Cain, J. D.; Hanson, E. D.; Hao, S.; Li, Q.; Castro, F. C.; Chen, X.; Dravid, V. P., Plasmon-Induced Interfacial Charge-Transfer Transition in Au@MoS<sub>2</sub> Heterostructures for Superior Plasmonic Photodetectors. *ACS Nano* 11 (10), **2017**, 10321-10329.
- 2017 Hanson, E. D.; Lajaunie, L.; Hao, S.; Myers, B. D.; Shi, F.; **Murthy, A. A.**; Wolverton, C.; Arenal, R.; Dravid, V. P., Systematic Study of Oxygen Vacancy Tunable Transport Properties of Few-Layer MoO<sub>3-x</sub> Enabled by Vapor-Based Synthesis. *Adv. Funct. Mater.* 27 (17), **2017**.
- 2016 Li, Y.; Cain, J. D.; Hanson, E. D.; **Murthy, A. A.**; Hao, S.; Shi, F.; Li, Q.; Wolverton, C.; Chen, X.; Dravid, V. P., Au@MoS<sub>2</sub> Core-Shell Heterostructures with Strong Light-Matter Interactions. *Nano Lett.* 16 (12), **2016**, 7696-7702.

\* denotes equal contribution.

## Recent Presentations

- 2024 **Murthy, A. A.**; Identifying and Mitigating Sources of Loss in Superconducting Qubits. *University of Oregon Physics Department Colloquium*, November 2024, Eugene, OR.
- 2024 **Murthy, A. A.**; Understanding and Eliminating Sources of Decoherence in Superconducting Qubits. *Northern Illinois University Physics Department Colloquium*, October 2024, DeKalb, IL.
- 2024 **Murthy, A. A.**; Understanding and Eliminating Materials Sources of Decoherence in Superconducting Qubits *SQMS Quantum for Science*, March 2024, London, UK.
- 2023 **Murthy, A. A.**; Advancements in Superconducting Quantum Hardware Guided by Materials Science *QSC Summer School*, April 2023, West Lafayette, IN.
- 2023 **Murthy, A. A.**; Systematic Improvements in Transmon Qubit Coherence Enabled by Comprehensive Investigation of Defects and Inhomogeneities. *Temple University Physics Department Colloquium*, April 2023, Philadelphia, PA.

## Leadership

- 2023–Present **Materials Focus Area Lead - SQMS Center.**  
Organized, approved and evaluated investigations conducted by 70 researchers across physics, materials science, and chemistry in the center to ensure compliance with the center's short-term and long-term goals
- 2022–2024 **Scientist Advisory Council - Fermilab .**  
Met regularly with the Fermilab Directorate to discuss topics of interest affecting both the short and long-term plans of the laboratory's research program as well as issues related to the career and professional goals of employees at the laboratory.

## Science Outreach

- 2023–Present **Center for Nanoscale Materials' (CNM) User Executive Committee (UEC) Member.**  
Served as an advocacy group for the CNM and its user community, provided advice to the CNM Director on matters affecting the user community, and ensured good communication between the CNM user community and CNM leadership. Was also responsible for organizing the scientific content for the annual joint Advanced Photon Source (APS)/CNM Users Meeting.
- 2023–2024 **Equity, Diversity and Inclusion Taskforce, Fermilab.**  
Worked to promote work environment that attracts and retains qualified talent and celebrates the diversity of experiences and perspectives in our workforce.

- 2021–2023 **Materials Research Society, Early Career Subcommittee Volunteer.**  
Helped organize "Meet the New Faculty Candidates" event giving current graduate students and postdoctoral researchers seeking faculty positions the opportunity to speak directly with faculty, recruiters, and department chairs. Also helped organize and prepare a manuscript aimed to help faculty applicants better understand the application review process based on survey responses from both applicants and faculty members.
- 2017–2020 **Materials Science Alliance for Inclusive Community (MatSAIC) seminar organizer.**  
Promoted inclusion and diversity in graduate study within STEM through quarterly seminar series. Invited 6 professors from a wide variety of backgrounds across the country to give talks about their personal career experience.
- 2017–2020 **Science in your Community Center (SICC) Volunteer.**  
Guided underrepresented 6th–8th grade students from Evanston's Fifth Ward through monthly science/engineering challenges.
- 2016–2020 **NUANCE Outreach Volunteer.**  
Conducted numerous instrument demonstrations for several events throughout the year including: Career Day for Girls, "Take Our Daughters & Sons to Work Day", various high school and college lab tours

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## Awards and Honors

- 2022 **Exceptional Performance Recognition Award, Fermilab.**  
For outstanding effort identifying loss mechanisms in superconducting qubits.
- 2022 **Exceptional Performance Recognition Award, SQMS Center.**  
For outstanding leadership in coordinating materials characterization studies throughout the center that centered on advancing knowledge of loss mechanisms in superconducting qubits.

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## Teaching

- Spring 2019 **MSE 360, Teaching Assistant, Northwestern University.**  
Taught undergraduate students the fundamentals of transmission electron microscopy and scanning electron microscopy through hands-on lab sessions
- Fall 2017 **MSE 190, Teaching Assistant, Northwestern University.**  
Taught undergraduate students the fundamentals of various characterization instrumentation through lab sessions and grading lab reports

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## Certificate

- 2019 **Management for Scientists and Engineers, Kellogg School of Management.**  
Certificate program taught by Kellogg faculty that equips promising post-candidacy doctoral students with the necessary business and leadership skills to succeed in academia and industry.