Stanford

Kunal Mukherjee

Assistant Professor of Materials Science and Engineering

Curriculum Vitae available Online

Bio

BIO

Kunal Mukherjee is an assistant professor in Materials Science and Engineering at Stanford. He has been an assistant professor in the Materials department at UC Santa Barbara (2016-2020), held postdoctoral appointments at IBM TJ Watson Research Center (2016) and MIT (2015), and worked as a transceiver engineer at Finisar (2009-2010).

The Mukherjee group specializes in semiconductors that emit and detect light in the infrared. Our research enables better materials for data transmission, sensing, manufacturing, and environmental monitoring. We make high-quality thin films with IV-VI (PbSnSe) and III-V (GaAs-InAs/GaSb) material systems and spend much of our time understanding how imperfections in the crystalline structure such as dislocations and point defects impact their electronic and optical properties. This holds the key to directly integrating these semiconductors with silicon and germanium substrates for new hybrid circuits that combine infrared photonics and conventional electronics.

ACADEMIC APPOINTMENTS

- Assistant Professor, Materials Science and Engineering
- Member, Bio-X

HONORS AND AWARDS

- Young Investigator Award, North American Molecular Beam Epitaxy Conference (2024)
- Nanoscale Emerging Investigators, Royal Society of Chemistry (2024)
- Young Scientist Award, International Symposium on Compound Semiconductors (2023)
- 2022-2023 Teaching Honor Roll, Stanford University (2023)
- Reid and Polly Anderson Faculty Fellow, Stanford University (2020-2022)
- Emerging Leaders - Journal of Physics D, Institute of Physics (2021)
- CAREER Award, National Science Foundation (2020)
- Corbett Prize, International Conference on Defects in Semiconductors (2019)
- PhD Fellowship, IBM (2014)
- Graduate Fellowship, Singapore-MIT Alliance (2007)
- President's Research Scholar, Nanyang Technological University (2004)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Materials Research Society (2012 - present)

PROFESSIONAL EDUCATION

- Ph. D., Massachusetts Institute of Technology , Materials Science and Engineering (2014)
- S. M., National University of Singapore , Advanced Materials for micro- and nano-systems (2009)
- M. Eng., Massachusetts Institute of Technology , Materials Science and Engineering (2008)
- B. Eng., Nanyang Technological University, Singapore , Electrical and Electronics (2007)

LINKS

- Mukherjee Group: https://crystal.sites.stanford.edu/

Teaching

COURSES

2025-26

- Defects and Disorder in Materials: MATSCI 183 (Spr)
- Defects and Disorder in Materials: MATSCI 213 (Spr)
- Defects in semiconductors: MATSCI 317 (Aut)
- Electronic Materials Engineering: MATSCI 152 (Win)

2024-25

- Defects and Disorder in Materials: MATSCI 183 (Spr)
- Defects and Disorder in Materials: MATSCI 213 (Spr)
- Electronic Materials Engineering: MATSCI 152 (Win)

2023-24

- Defects and Disorder in Materials: MATSCI 183 (Spr)
- Defects and Disorder in Materials: MATSCI 213 (Spr)
- Electronic Materials Engineering: MATSCI 152 (Win)

2022-23

- Defects and Disorder in Materials: MATSCI 183 (Spr)
- Defects and Disorder in Materials: MATSCI 213 (Spr)
- Defects in semiconductors: MATSCI 317 (Aut)
- Electronic Materials Engineering: MATSCI 152 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Diego Rivera

Postdoctoral Faculty Sponsor

Ashlee Garcia

Doctoral Dissertation Advisor (AC)

Maria Aguiar Duarte, Kira Martin, Tri Nguyen, SeongJin Park, Kelly Xiao

Master's Program Advisor

Joey Chieu

Doctoral Dissertation Co-Advisor (AC)

Luis Delfin Manriquez, Zahra Heussen, Jackson Meng, Devansh Saraswat, Alexandra Zimmerman

Publications

PUBLICATIONS

- **Epitaxial growth of anisotropic SnSe on GaAs(001) via step-edge orientation control** *JOURNAL OF APPLIED PHYSICS*
  Reddy, P. D., Heussen, Z. N., Mukherjee, K.
  2026; 139 (17)
- **III-V-on-Si Midwave Infrared Photodetectors with High Operating Temperature** *CRYSTAL GROWTH & DESIGN*
  Garrett, T. A., Vallejo, K. D., Nordstrom, M. D., Reddy, P. D., Murkute, P., Liang, B., Grossklaus, K. A., Mukherjee, K., Krishna, S., Maimon, S., Simmonds, P. J.
  2026
- **Solid-phase heteroepitaxy of oriented Sb₂Se₃ on GaAs for birefringent thin films** *JOURNAL OF VACUUM SCIENCE & TECHNOLOGY A*
  Xiao, K., Shen, Y., Vailionis, A., Skipper, A. M., Preidl, A., Lindenberg, A. M., Mukherjee, K.
  2026; 44 (2)
- **Mid-Infrared LEDs Based on Lattice-Mismatched Hybrid IV-VI/III-V Heterojunctions** *ADVANCED OPTICAL MATERIALS*
  Meyer, J. E., Rodriguez, B., Nordin, L., Mukherjee, K.
  2026
- **Reversible Polymorph Switching in IV-VI Thin Films with Epitaxial Control and Birefringence Contrast.** *Nano letters*
  Reddy, P. D., Tara, V., Vailionis, A., Majumdar, A., Mukherjee, K.
  2025
- **Scalable nanoscale positioning of highly coherent color centers in prefabricated diamond nanostructures.** *Nature communications*
  Kim, S., London, P., Yang, D., Hughes, L. B., Ahlers, J., Meynell, S., Mitchell, W. J., Mukherjee, K., Bleszynski Jayich, A. C.
  2025; 16 (1): 9803
- **Heteroepitaxial growth of highly anisotropic Sb2Se3 films on GaAs.** *Materials horizons*
  Xiao, K., Tara, V., Reddy, P. D., Meyer, J. E., Skipper, A. M., Chen, R., Nordin, L. J., Majumdar, A., Mukherjee, K.
  2025
- **Strongly Interacting, Two-Dimensional, Dipolar Spin Ensembles in (111)-Oriented Diamond** *PHYSICAL REVIEW X*
  Hughes, L. B., Meynell, S. A., Wu, W., Parthasarathy, S., Chen, L., Zhang, Z., Wang, Z., Davis, E. J., Mukherjee, K., Yao, N. Y., Jayich, A.
  2025; 15 (2)
- **Epitaxial PbGeSe thin films and their photoluminescence in the mid-wave infrared** *JOURNAL OF APPLIED PHYSICS*
  Xiao, K., Wong, B., Meyer, J., Nordin, L., Mukherjee, K.
  2025; 137 (14)
- **Engineering PbSnSe Heterostructures for Luminescence Out to 8 μm at Room Temperature** *ADVANCED OPTICAL MATERIALS*
  Meyer, J. E., Nordin, L., Carrasco, R. A., Webster, P. T., Dumont, M., Mukherjee, K.
  2024
- **Role of oxygen in laser-induced contamination at diamond-vacuum interfaces** *PHYSICAL REVIEW APPLIED*
  Parthasarathy, S., Joos, M., Hughes, L. B., Meynell, S. A., Morrison, T. A., Risner-Jamtgaard, J. D., Weld, D. M., Mukherjee, K., Jayich, A.
  2024; 22 (2)
- **Expanded Stability of Layered SnSe-PbSe Alloys and Evidence of Displacive Phase Transformation from Rocksalt in Heteroepitaxial Thin Films.** *ACS nano*
  Reddy, P. D., Nordin, L. J., Hughes, L. B., Preidl, A. K., Mukherjee, K.
  2024
- **Gradual degradation in InAs quantum dot lasers on Si and GaAs.** *Nanoscale*
  Hughes, E. T., Shang, C., Selvidge, J., Jung, D., Wan, Y., Herrick, R. W., Bowers, J. E., Mukherjee, K.

2024

- **Sputtered SnTe Thin Films on Si and Ge as a Plasmonic Material** *ACS APPLIED ELECTRONIC MATERIALS*
  Nguyen, T., Nordin, L., Mukherjee, K.
  2024

- **Direct Integration of GaSb with GaAs(111)A Using Interfacial Misfit Arrays** *CRYSTAL GROWTH & DESIGN*
  Nordstrom, M. D., Garrett, T. A., Reddy, P., McElearney, J., Rushing, J. R., Vallejo, K. D., Mukherjee, K., Grossklaus, K. A., Vandervelde, T. E., Simmonds, P. J.
  2023

- **Mid-wave infrared photoluminescence from low-temperature-grown PbSe epitaxial films on GaAs after rapid thermal annealing** *APPLIED PHYSICS LETTERS*
  Meyer, J. E., Nordin, L., Nguyen, T., Mukherjee, K.
  2023; 123 (13)

- **Dislocation-Induced Structural and Luminescence Degradation in InAs Quantum Dot Emitters on Silicon** *PHYSICA STATUS SOLIDI A-APPLICATIONS AND MATERIALS SCIENCE*
  Hughes, E. T., Kusch, G., Selvidge, J., Bonef, B., Norman, J., Shang, C., Bowers, J. E., Oliver, R. A., Mukherjee, K.
  2023

- **Versatile strain relief pathways in epitaxial films of (001)-oriented PbSe on III-V substrates** *PHYSICAL REVIEW MATERIALS*
  Haidet, B. B., Meyer, J., Reddy, P., Hughes, E. T., Mukherjee, K.
  2023; 7 (2)

- **Two-dimensional spin systems in PECVD-grown diamond with tunable density and long coherence for enhanced quantum sensing and simulation** *APL MATERIALS*
  Hughes, L. B., Zhang, Z., Jin, C., Meynell, S. A., Ye, B., Wu, W., Wang, Z., Davis, E. J., Mates, T. E., Yao, N. Y., Mukherjee, K., Jayich, A. C.
  2023; 11 (2)

- **Optically thick GaInAs/GaAsP strain-balanced quantum-well tandem solar cells with 29.2% efficiency under the AM0 space spectrum** *JOURNAL OF APPLIED PHYSICS*
  France, R. M., Selvidge, J., Mukherjee, K., Steiner, M. A.
  2022; 132 (18)

- **Dislocation Formation and Filtering in III-V Regrowth on GaAs Bonded on Si** *CRYSTAL GROWTH & DESIGN*
  Hughes, E. T., Dumont, M., Hu, Y., Liang, D., Beausoleil, R. G., Bowers, J. E., Mukherjee, K.
  2022

- **Epitaxial Integration and Defect Structure of Layered SnSe Films on PbSe/III-V Substrates** *CRYSTAL GROWTH & DESIGN*
  Haidet, B. B., Hughes, E., Mukherjee, K.
  2022

- **Kinetically limited misfit dislocations formed during post-growth cooling in III-V lasers on silicon** *JOURNAL OF PHYSICS D-APPLIED PHYSICS*
  Mukherjee, K., Selvidge, J., Hughes, E., Norman, J., Shang, C., Herrick, R., Bowers, J.
  2021; 54 (49)

- **Bright mid-infrared photoluminescence from high dislocation density epitaxial PbSe films on GaAs** *APL MATERIALS*
  Meyer, J., Muhowski, A. J., Nordin, L., Hughes, E., Haidet, B., Wasserman, D., Mukherjee, K.
  2021; 9 (11)

- **Perspectives on Advances in Quantum Dot Lasers and Integration with Si Photonic Integrated Circuits** *ACS PHOTONICS*
  Shang, C., Wan, Y., Selvidge, J., Hughes, E., Herrick, R., Mukherjee, K., Duan, J., Grillot, F., Chow, W. W., Bowers, J. E.
  2021; 8 (9): 2555-2566

- **Pipe-diffusion-enriched dislocations and interfaces in SnSe/PbSe heterostructures** *PHYSICAL REVIEW MATERIALS*
  Hughes, E. T., Haidet, B. B., Bonef, B., Cai, W., Mukherjee, K.
  2021; 5 (7)

- **High-temperature reliable quantum-dot lasers on Si with misfit and threading dislocation filters** *OPTICA*

Shang, C., Hughes, E., Wan, Y., Dumont, M., Koscica, R., Selvidge, J., Herrick, R., Gossard, A. C., Mukherjee, K., Bowers, J. E.
2021; 8 (5): 749-754

- **Reduced dislocation growth leads to long lifetime InAs quantum dot lasers on silicon at high temperatures** *APPLIED PHYSICS LETTERS*
  Selvidge, J., Hughes, E. T., Norman, J. C., Shang, C., Kennedy, M. J., Dumont, M., Netherton, A. M., Zhang, Z., Herrick, R. W., Bowers, J. E., Mukherjee, K.
  2021; 118 (19)
- **Interface structure and luminescence properties of epitaxial PbSe films on InAs(111)A** *JOURNAL OF VACUUM SCIENCE & TECHNOLOGY A*
  Haidet, B. B., Nordin, L., Muhowski, A. J., Vallejo, K. D., Hughes, E. T., Meyer, J., Simmonds, P. J., Wasserman, D., Mukherjee, K.
  2021; 39 (2)
- **Ferroelastic Hysteresis in Thin Films of Methylammonium Lead Iodide** *CHEMISTRY OF MATERIALS*
  Kennard, R. M., Dahlman, C. J., DeCrescent, R. A., Schuller, J. A., Mukherjee, K., Seshadri, R., Chabinyc, M. L.
  2021; 33 (1): 298–309
- **High temperature reliable epitaxially grown quantum dot lasers on (001) Si with record performance**
  Shang, C., Hughes, E., Wan, Y., Dumont, M., Koscica, R., Selvidge, J., Herrick, R., Gossard, A. C., Mukherjee, K., Bowers, J. E., IEEE
  IEEE.2021
- **Degradation Behaviors in InAs Quantum Dot Lasers on Silicon using Misfit Dislocation Trapping Layers**
  Selvidge, J., Hughes, E. T., Shang, C., Herrick, R. W., Bowers, J. E., Mukherjee, K., IEEE
  IEEE.2021
- **Controlling facets and defects of InP nanostructures in confined epitaxial lateral overgrowth** *PHYSICAL REVIEW MATERIALS*
  Goswami, A., Brunelli, S., Markman, B., Taylor, A. A., Tseng, H., Mukherjee, K., Rodwell, M., Klamkin, J., Palmstrom, C. J.
  2020; 4 (12)
- **Engineering quantum-coherent defects: The role of substrate miscut in chemical vapor deposition diamond growth** *APPLIED PHYSICS LETTERS*
  Meynell, S. A., McLellan, C. A., Hughes, L. B., Wang, W., Mates, T. E., Mukherjee, K., Jayich, A.
  2020; 117 (19)
- **Defect filtering for thermal expansion induced dislocations in III-V lasers on silicon** *APPLIED PHYSICS LETTERS*
  Selvidge, J., Norman, J., Hughes, E. T., Shang, C., Jung, D., Taylor, A. A., Kennedy, M. J., Herrick, R., Bowers, J. E., Mukherjee, K.
  2020; 117 (12)
- **A Pathway to Thin GaAs Virtual Substrate on On-Axis Si (001) with Ultralow Threading Dislocation Density** *PHYSICA STATUS SOLIDI A-APPLICATIONS AND MATERIALS SCIENCE*
  Shang, C., Selvidge, J., Hughes, E., Norman, J. C., Taylor, A. A., Gossard, A. C., Mukherjee, K., Bowers, J. E.
  2020
- **Recombination-enhanced dislocation climb in InAs quantum dot lasers on silicon** *JOURNAL OF APPLIED PHYSICS*
  Mukherjee, K., Selvidge, J., Jung, D., Norman, J., Taylor, A. A., Salmon, M., Liu, A. Y., Bowers, J. E., Herrick, R. W.
  2020; 128 (2)
- **Nucleation control and interface structure of rocksalt PbSe on (001) zincblende III-V surfaces** *PHYSICAL REVIEW MATERIALS*
  Haidet, B. B., Hughes, E. T., Mukherjee, K.
  2020; 4 (3)
- **Development of Lattice-Mismatched GaInAsP for Radiation Hardness** *IEEE JOURNAL OF PHOTOVOLTAICS*
  France, R. M., Espinet-Gonzalez, P., Haidet, B. B., Mukherjee, K., Guthrey, H. L., Atwater, H. A., Walker, D.
  2020; 10 (1): 103–8
- **Defects in Cd3As2 epilayers via molecular beam epitaxy and strategies for reducing them** *PHYSICAL REVIEW MATERIALS*
  Rice, A. D., Park, K., Hughes, E. T., Mukherjee, K., Alberi, K.
  2019; 3 (12)
- **III/V-on-Si MQW lasers by using a novel photonic integration method of regrowth on a bonding template** *LIGHT-SCIENCE & APPLICATIONS*
  Hu, Y., Liang, D., Mukherjee, K., Li, Y., Zhang, C., Kurczveil, G., Huang, X., Beausoleil, R. G.
  2019; 8: 93

- **Growth and Magnetotransport in Thin-Film alpha-Sn on CdTe** *PHYSICA STATUS SOLIDI B-BASIC SOLID STATE PHYSICS*
  Vail, O., Taylor, P., Folkes, P., Nichols, B., Haidet, B., Mukherjee, K., de Coster, G.
  2020; 257 (1)
- **Non-radiative recombination at dislocations in InAs quantum dots grown on silicon** *APPLIED PHYSICS LETTERS*
  Selvidge, J., Norman, J., Salmon, M. E., Hughes, E. T., Bowers, J. E., Herrick, R., Mukherjee, K.
  2019; 115 (13)
- **Phase Stability and Diffusion in Lateral Heterostructures of Methyl Ammonium Lead Halide Perovskites** *ACS APPLIED MATERIALS & INTERFACES*
  Kennard, R. M., Dahlman, C. J., Nakayama, H., DeCrescent, R. A., Schuller, J. A., Seshadri, R., Mukherjee, K., Chabinyc, M. L.
  2019; 11 (28): 25313–21
- **Glide of threading dislocations in (In)AlGaAs on Si induced by carrier recombination: Characteristics, mitigation, and filtering** *JOURNAL OF APPLIED PHYSICS*
  Hughes, E. T., Shah, R. D., Mukherjee, K.
  2019; 125 (16)
- **Anomalous tilting in InGaAs graded buffers from dislocation sources at wafer edges** *JOURNAL OF CRYSTAL GROWTH*
  Mukherjee, K., Vaisman, M., Callahan, P. G., Lee, M.
  2019; 512: 169–75
- **Fast Diffusion and Segregation along Threading Dislocations in Semiconductor Heterostructures** *NANO LETTERS*
  Bonef, B., Shah, R. D., Mukherjee, K.
  2019; 19 (3): 1428–36
- **Contribution of top barrier materials to high mobility in near-surface InAs quantum wells grown on GaSb(001)** *PHYSICAL REVIEW MATERIALS*
  Lee, J., Shojaei, B., Pendharkar, M., Feldman, M., Mukherjee, K., Palmstrom, C. J.
  2019; 3 (1)
- **Recent Advances in InAs Quantum Dot Lasers Grown on On-Axis (001) Silicon by Molecular Beam Epitaxy** *PHYSICA STATUS SOLIDI A-APPLICATIONS AND MATERIALS SCIENCE*
  Jung, D., Norman, J., Wan, Y., Liu, S., Herrick, R., Selvidge, J., Mukherjee, K., Gossard, A. C., Bowers, J. E.
  2019; 216 (1)
- **Direct observation of recombination-enhanced dislocation glide in heteroepitaxial GaAs on silicon** *PHYSICAL REVIEW MATERIALS*
  Callahan, P. G., Haidet, B. B., Jung, D., Seward, G. G. E., Mukherjee, K.
  2018; 2 (8)
- **Recombination activity of threading dislocations in GaInP influenced by growth temperature** *JOURNAL OF APPLIED PHYSICS*
  Mukherjee, K., Reilly, C. H., Callahan, P. G., Seward, G. E.
  2018; 123 (16)
- **Low threading dislocation density GaAs growth on on-axis GaP/Si (001)** *JOURNAL OF APPLIED PHYSICS*
  Jung, D., Callahan, P. G., Shin, B., Mukherjee, K., Gossard, A. C., Bowers, J. E.
  2017; 122 (22)
- **Rapid imaging of misfit dislocations in SiGe/Si in cross-section and through oxide layers using electron channeling contrast** *APPLIED PHYSICS LETTERS*
  Mukherjee, K., Wacaser, B. A., Bedell, S. W., Sadana, D. K.
  2017; 110 (23)
- **Praseodymium Cuprate Thin Film Cathodes for Intermediate Temperature Solid Oxide Fuel Cells: Roles of Doping, Orientation, and Crystal Structure.** *ACS applied materials & interfaces*
  Mukherjee, K., Hayamizu, Y., Kim, C. S., Kolchina, L. M., Mazo, G. N., Istomin, S. Y., Bishop, S. R., Tuller, H. L.
  2016; 8 (50): 34295-34302
- **Direct-Gap 2.1-2.2 eV AlInP Solar Cells on GaInAs/GaAs Metamorphic Buffers** *IEEE JOURNAL OF PHOTOVOLTAICS*
  Vaisman, M., Mukherjee, K., Masuda, T., Yaung, K., Fitzgerald, E. A., Lee, M.

2016; 6 (2): 571–77

- **Spontaneous lateral phase separation of AlInP during thin film growth and its effect on luminescence** *JOURNAL OF APPLIED PHYSICS*
  Mukherjee, K., Norman, A. G., Akey, A. J., Buonassisi, T., Fitzgerald, E. A.
  2015; 118 (11)
- **Improved photoluminescence characteristics of order-disorder AlGaInP quantum wells at room and elevated temperatures** *APPLIED PHYSICS LETTERS*
  Mukherjee, K., Deotare, P. B., Fitzgerald, E. A.
  2015; 106 (14)
- **Effects of dislocation strain on the epitaxy of lattice-mismatched AlGaInP layers** *JOURNAL OF CRYSTAL GROWTH*
  Mukherjee, K., Beaton, D. A., Mascarenhas, A., Bulsara, M. T., Fitzgerald, E. A.
  2014; 392: 74–80
- **Determination of the direct to indirect bandgap transition composition in AlxIn1-xP** *JOURNAL OF APPLIED PHYSICS*
  Beaton, D. A., Christian, T., Alberi, K., Mascarenhas, A., Mukherjee, K., Fitzgerald, E. A.
  2013; 114 (20)
- **Amber-green light-emitting diodes using order-disorder AlxIn1-xP heterostructures** *JOURNAL OF APPLIED PHYSICS*
  Christian, T. M., Beaton, D. A., Mukherjee, K., Alberi, K., Fitzgerald, E. A., Mascarenhas, A.
  2013; 114 (7)
- **Growth, microstructure, and luminescent properties of direct-bandgap InAlP on relaxed InGaAs on GaAs substrates** *JOURNAL OF APPLIED PHYSICS*
  Mukherjee, K., Beaton, D. A., Christian, T., Jones, E. J., Alberi, K., Mascarenhas, A., Bulsara, M. T., Fitzgerald, E. A.
  2013; 113 (18)
- **Silicon CMOS Ohmic Contact Technology for Contacting III-V Compound Materials** *ECS JOURNAL OF SOLID STATE SCIENCE AND TECHNOLOGY*
  Pacella, N. Y., Mukherjee, K., Bulsara, M. T., Fitzgerald, E. A.
  2013; 2 (7): P324–P331
- **Electron transport in electrospun TiO2 nanofiber dye-sensitized solar cells** *APPLIED PHYSICS LETTERS*
  Mukherjee, K., Teng, T., Jose, R., Ramakrishna, S.
  2009; 95 (1)