

Eldred Lee, Ph.D.

Contact Information

Office: 1140 E. Arques Ave, Sunnyvale, CA 94085 USA
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Current Appointment

Account Technologist
Dielectric Deposition Products (DDP)
Semiconductor Products Group (SPG)
Applied Materials

Education

Ph.D. in Electrical & Computer Engineering
Research Subfield: Electronic Materials & Devices
Dartmouth College, October 2021
Dissertation: *Towards the Photonic Efficiency Enhancement of Solar-Selective Absorbers and Si-Based High-Energy X-ray Detectors*

B.E. in Biomedical Engineering
Track: Biomedical Instrumentation & Devices
Dartmouth College, March 2017
Capstone Project: *Cerebral Shunt with Continuous Failure Monitoring*

Ph.D. Dissertation Projects

- Novel high-Z photon attenuation material-Si two-layer high-energy X-ray (>20 keV) detectors with significantly enhanced photonic efficiency (funded by Los Alamos National Laboratory & US DOE NNSA LRGF)
- Thermodynamically stable, plasmonic transition metal oxide nanoparticle solar selective absorbers towards 95% optical-to-thermal conversion efficiency at 750°C (funded by US DOE)
- Native oxide solar absorbers on high entropy alloys for concentrated solar power systems (funded by US DOE)

Broad Research & Technical Interests

- Semiconductor device process development, optimization, integration, and fabrication
 - Carbon & oxide CVD / PECVD process for advanced memory & logic
 - Dielectric CVD patterning application process technology for advanced memory & logic (gapfill & hardmask process)
 - CVD process integration in current & next generation devices
 - Patterning application etch process development for advanced memory & logic
 - Process development for X-ray Si CIS or QIS fabrication

- Interdisciplinary materials + EE applications for X-ray detectors, CIS, clean energy technologies, and medicine, including but not limited to:
 - Efficient high-energy X-ray detectors for HSI applications
 - Nanostructures for efficient photon trapping
 - Solar-selective absorbers for high-efficiency CSP systems
 - Biocompatible materials for implantable neurosurgical devices
 - Nanoparticles for brain and neural tumor treatment

Previous STEM R&D Appointments

DOE NNSA LRGF Fellow High-Speed Imaging Team Group P-4 Thermonuclear Plasma Physics & P-25 Subatomic Physics Los Alamos National Laboratory	Fall 2019 – Fall 2021
Graduate Research Assistant “Life of Light” Laboratory Thayer School of Engineering Dartmouth College	Winter 2017 – Fall 2021
Process Engineer (Intern) - Etch Varian Semiconductor Equipment Advanced Products Group Semiconductor Products Group (SPG) Applied Materials	Spring 2019 – Summer 2019
Undergraduate Research Assistant Power Electronics Laboratory Department of Electrical Engineering Universität der Bundeswehr Hamburg	Summer 2015

Undergraduate Research Assistant
Experimental Geoplasma Physics Laboratory
Department of Physics and Astronomy
Dartmouth College

Fall 2014

Awards & Honors

Laboratory Residency Graduate Fellowship
National Nuclear Security Administration
United States Department of Energy, Apr. 2019

The Class of 1968 Crowd Funding Grant
The Magnuson Center for Entrepreneurship
Dartmouth College, Nov. 2018

SPIE Optics + Photonics Student Travel Grant
2018 SPIE Optics + Photonics: Nanoscience + Engineering
International Society for Optics & Photonics (SPIE), June 2018

Outstanding Undergraduate Design Award
43rd IEEE Northeast Bioengineering Conference (NEBEC 2017)
New Jersey Institute of Technology, Mar. 2017

John F. Warren 1971 (Thayer 1972) Fellowship
Thayer School of Engineering
Dartmouth College, Sept. 2016

Winner, "The Pitch"
Digital Arts Leadership and Innovation (DALI) Lab
Dartmouth College, Nov. 2014

Publications & Technical Reports

K.M. Anagnost, **E. Lee**, Z. Wang, J. Liu, E.R. Fossum, "Simulating 50 keV X-ray photon detection in silicon with a down-conversion layer," *Sensors* **21**, 7566 (2021); <https://doi.org/10.3390/s21227566>

E. Lee, K.M. Anagnost, Z. Wang, M.R. James, E.R. Fossum, J. Liu, "Monte Carlo modeling and design of photon energy attenuation layers for >10x quantum yield enhancement in Si-based hard X-ray detectors," *Instruments* **5**, 17 (2021); <https://doi.org/10.3390/instruments5020017>

Z. Wang, K.M. Anagnost, C.W. Barnes, D.M. Dattelbaum, E.R. Fossum, **E. Lee**, J. Liu, J.J. Ma, W.Z. Meijer, W. Nie, C.M. Sweeney, A.C. Therrien, H. Tsai, X. Yue, "Billion-pixel X-ray camera (BiPC-X)," *Rev. Sci. Instrum.* **92**, 043708 (2021); <https://doi.org/10.1063/5.0043013>

X. Wang, **E. Lee**, C. Xu, J. Liu, "High-efficiency, air-stable, manganese-iron oxide nanoparticle-pigmented solar selected absorber coating towards concentrated solar power systems operating at 750°C," *Mater. Today Energy* **19**, 100609 (2021); <https://doi.org/10.1016/j.mtener.2020.100609>

E. Lee, Z. Wang, M. James, J. Liu, "Monte Carlo simulation and design of high-energy X-ray detection concept with enhanced efficiency using high-Z semiconductor photon attenuation materials," *OSA Tech. Dig.* **NoTu2F.3** (2020); <https://doi.org/10.1364/NOMA.2020.NoTu2F.3>

Z. Wang, K. Anagnost, C.W. Barnes, D.M. Dattelbaum, E.R. Fossum, **E. Lee**, J. Liu, J.J. Ma, W. Nie, C.M. Sweeney, A.C. Therrien, H. Tsai, X. Yue, "A billion-pixel camera (BiPC) for wide field-of-view X-ray applications," *Los Alamos National Laboratory Report No. LA-UR-20-20843* (2020)

H. Tsai, **E. Lee**, K. Anagnost, E.R. Fossum, O. Iaroshenko, M.R. James, J. Liu, W. Nie, Z. Wang, "High-speed imaging detectors for high-energy photons," *Los Alamos National Laboratory Report No. LA-UR-19-32601* (2019)

Z. Wang, C.W. Barnes, D.M. Dattelbaum, E.R. Fossum, **E. Lee**, J. Liu, J.J. Ma, R. Pokharel, Y.H. Sechrest, C.M. Sweeney, A.C. Therrien, "A billion-pixel camera (BiPC) for wide field-of-view measurements in synchrotrons and X-ray Free Electron Lasers," *Los Alamos Report National Laboratory Report No. LA-UR-19-27804* (2019)

C. Xu, **E. Lee**, X. Wang, J. Liu, "High-efficiency, high-temperature, air-stable Cu, Mn and Fe oxide nanoparticle-pigmented silicone solar selective coatings via hot spray-coating method," *OSA Tech. Dig.* **PW3C.6** (2019); <https://doi.org/10.1364/PVLED.2019.PW3C.6>

S. Mitchell, W. Kahouli, G. Grangard, A.J. Crain, C. Dalldorf, **E. Lee**, A. Hamlin, L. Feeney, H. Johnstone, G.P. Luke, S.G. Diamond, D.F. Bauer, "Snap-valve cerebral shunt design for intracranial pressure operation and ultrasound visualization," *Med. Eng. Phys.* **66**, 1-11 (2019); <https://doi.org/10.1016/j.medengphy.2018.12.024>

E. Lee, K. Kekalo, C. Xu, X. Wang, J. Liu, "MnFe₂O₄ and MnO₂ nanoparticle-based high-temperature, air-stable, long-term antioxidation cermet solar selective absorbers," *Proc. SPIE* **10730**, 107300B (2018); <https://doi.org/10.1117/12.2319957>

X. Wang, X. Yu, S. Fu, **E. Lee**, K. Kekalo, J. Liu, "Design and optimization of nanoparticle-pigmented solar selective absorber coatings for high-temperature concentrated solar power systems," *J. Appl. Phys.* **123**, 033104 (2018); <https://doi.org/10.1063/1.5009252>

Patents

US Patent: "Cerebral shunt valve," issued April 2022 (11,305,099 B1)

US Provisional Patent Application: "Hard X-ray detectors with photon energy attenuation and electron generation-detection layers with integration capability to CMOS image sensor (CIS)-based or quanta image sensor (QIS)-based devices," filed October 2019 (62/704,068)

US Patent Application Publication: "Solar receiver, selectively absorbing material, and associated fabrication methods," published November 2021; filed August 2021 (US 2021/0348023 A1)

Presentations (* indicates presenter; ^ indicates oral presentation; # indicates poster presentation)

E. Lee^{*}, "Towards the photonic efficiency enhancement of Si-based high-energy X-ray detectors," 2022 DOE NNSA SSGF/LRGF Program Review, Santa Fe, NM, June 2022 [^]

E. Lee^{*}, K.M. Anagnost, X. Yue, J.K.S. Baldwin, C.G. Levey, Z. Wang, E.R. Fossum, J. Liu, "Towards the quantum yield enhancement of high-energy X-ray detection by Si CMOS image sensors using high-Z thin-film semiconductor photon energy attenuation layers," 2021 DOE NNSA SSGF/LRGF Program Review, Ames, IA (virtual), Aug. 2021 [#]

E. Lee^{*}, Z. Wang, M.R. James, E.R. Fossum, K. Anagnost, J. Liu, "Monte Carlo simulation and design of novel high-Z photon attenuation material-Si two-layer high-energy X-ray detectors with significantly enhanced efficiency," 2020 MRS Fall Meeting, Boston, MA (virtual), Nov. 2020 [#]

E. Lee^{*}, K.M. Anagnost, J. Liu, E.R. Fossum, X. Yue, M.R. James, Z. Wang, "Monte Carlo simulation and design of high-Z semiconductor material – Si tandem concept for hard X-ray detection with improved efficiency," 2020 IEEE Nuclear Science Symposium & Medical Imaging Conference, Boston, MA (virtual), Nov. 2020 [#]

E. Lee^{*}, M.R. James, Z. Wang, J. Liu, "Monte Carlo simulation and design of high-energy X-ray detection concept with enhanced efficiency using high-Z semiconductor photon attenuation materials," OSA Advanced Photonics Congress 2020, Montreal, QC, Canada (virtual), July 2020 [^]

E. Lee*, M.R. James, Z. Wang, J. Liu, "Monte Carlo simulation and design of novel high-Z photon attenuation material-Si two-layer high-energy X-ray detectors with significantly enhanced efficiency," *2020 NNSA SSAP Symposium*, Washington DC, Feb. 2020 #

C. Xu*, **E. Lee**, X. Wang, J. Liu, "High-efficiency, high-temperature, air-stable Cu, Mn and Fe oxide nanoparticle-pigmented silicone solar selective coatings via hot spray-coating method," *OSA Advanced Photonics Congress*, Burlingame, CA, July 2019 ^

E. Lee*, M. Wu, S. Somers, I. Baker, J. Liu, "FeMnNiAlCr high entropy alloys (HEAs) and their native oxide solar absorbers for concentrated solar power systems," *2018 MRS Fall Meeting*, Boston, MA, Nov. 2018 ^

C. Xu*, **E. Lee**, X. Wang, J. Liu, "High-efficiency, high-temperature Cu and Mn oxides nanoparticle-pigmented anti-oxidation solar selective coatings via spray-coating method," *2018 MRS Fall Meeting*, Boston, MA, Nov. 2018 #

E. Lee*, C. Xu, K. Kekalo, X. Wang, J. Liu, "MnFe₂O₄ nanoparticle-based high-temperature, air-stable, long-term antioxidation solar selective absorbers," *2018 MRS Fall Meeting*, Boston, MA, Nov. 2018 ^

E. Lee*, K. Kekalo, C. Xu, X. Wang, J. Liu, "MnFe₂O₄ and MnO₂ nanoparticle-based high-temperature, air-stable, long-term antioxidation cermet solar selective absorbers," *SPIE Optics and Photonics: Nanoscience and Engineering Conference 2018*, San Diego, CA, Aug. 2018 ^

A. Crain, L. Feeney, A. Hamlin, H. Johnstone, **E. Lee***, "Cerebral shunt with continuous failure monitoring," *43rd IEEE Northeast Bioengineering Conference*, Newark, NJ, Mar. 2017 #

Teaching

MATH 212R: Multivariate Calculus River Valley Community College Role: Instructor (full responsibility)	No. of Terms: 1
ENGS 134: Nanotechnology Dartmouth College Role: Course & Laboratory TA	No. of Terms: 4
ENGS 133: Methods of Materials Characterization Dartmouth College Role: Course TA	No. of Terms: 1

ENGS 131: Science of Solid State Materials Dartmouth College Role: Course & Laboratory TA	No. of Terms: 3
ENGS 25: Intro. to Thermodynamics Dartmouth College Role: Course TA	No. of Terms: 3
ENGS 24: Science of Materials Dartmouth College Role: Course Teaching Assistant, Project Advisor	No. of Terms: 8
ENGS 22: Systems Dartmouth College Role: Course & Laboratory Teaching Assistant	No. of Terms: 2

Undergraduate Research Advising

Undergraduate Honors Thesis in Engineering Sciences Student: Kevin Larkin (Dartmouth, A.B. '22 & B.E. '22) Topic: High energy X-ray Si CIS fabrication & characterization Current: Incoming MSE Ph.D. student at Carnegie Mellon University	Fall 2021
Undergraduate Research Assistantship Student: Sarah Chong (Dartmouth, A.B. '21) Topic: Wireless optical power delivery using nanophotonic antennas & nanoparticle-pigmented solar selective absorber coatings Current: Year 2 Chemistry Ph.D. student at NYU	Spring 2019 – Spring 2020
Undergraduate Honors Thesis in Engineering Sciences Undergraduate Research Assistantship Student: Sheppard Somers (Dartmouth, A.B. '19 & B.E. '19) Topic: Using native oxides on high entropy alloys as solar absorbers Current: Associate Managing Consultant at Mastercard Data & Services	Spring 2019 Spring 2017 – Summer 2018

Reviewed Academic Journals

- Nano-Micro Letters (Springer; IF: 23.655)
- Solar Energy (Elsevier; IF: 7.188)
- Optical Materials (Elsevier; '21 IF: 3.754)

Professional Memberships

- Institute of Electrical and Electronics Engineers (IEEE)
- Materials Research Society (MRS)
- International Society for Optics & Photonics (SPIE)

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