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RESEARCH & COLLABORATION PROFILE |

KEY WORDS: Semiconductor Nanostructures, Perovskites, 2D materials, Composites, Optoelectronics, Sensors

Research Snapshot. Prof. Lee engineers low-dimensional semiconductor and carbon nanomaterials and investigates how nanoscale structure, surfaces, and interfaces govern optical, electrical, thermal, and chemical behavior. His research integrates controlled growth of ZnO, GaN, perovskite, carbon nanotube, and graphene-based structures with photoluminescence, charge-transport, and device studies for photodetectors, radiation detectors, light emitters, photoelectrochemical systems, thermal management, and optical sensing.

RESEARCH EXPERTISE

- **Semiconductor nanostructure synthesis:** selective growth and characterization of 0D-3D ZnO, GaN, and perovskite structures with dimensionality and morphology control.
- **Nanoscale photophysics & interfaces:** optical dynamics, charge transfer, and recombination at surfaces and interfaces using photoluminescence and device-level electrical analysis.
- **Perovskite optoelectronics:** quantum dots and CVD-grown microplates for wavelength-selective photodetection, memory devices, and radiation detection.
- **Carbon nanomaterials:** CNT and graphene growth and carbon-metal heterostructures for interconnects, heat dissipation, electroforming, and flexible devices.
- **Functional nanocomposites & sensors:** high-surface-area 3D composites and optical-fiber platforms for environmental, biosensing, adsorption, and energy applications.

RECENT RESEARCH HIGHLIGHTS

- **Perovskite photophysics (J. Mater. Chem. C 2026):** compared the optical characteristics of $CsPbBr_3$ quantum dots and CVD-grown microplates across distinct material dimensions.
- **Wavelength-selective photodetection (Mater. Today Phys. 2026):** reported perovskite-QD-induced wavelength-dependent photoresponse changes in graphene photodetectors.
- **Light-driven nanocrystal evolution (Appl. Surf. Sci. 2026):** examined illumination-induced morphological and optical changes in $CsPbBr_3$ nanocrystals.

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas: semiconductor nanostructures | perovskite optoelectronics | nanocarbon composites | sensing & photoelectrochemistry

1. **Low-dimensional semiconductor growth:** co-design ZnO, GaN, and perovskite-based nanostructures, and heterostructures with tailored morphology and interfaces.
2. **Perovskite-carbon optoelectronics:** integrate perovskites with graphene or CNT electrodes to control charge transfer for energy conversion and optoelectronic devices.
3. **Thermal & electrical nanocomposites:** develop carbon-metal interfaces, porous heat spreaders, and high-current interconnects for advanced electronic packaging.
4. **Sensors & photoelectrochemistry:** combine optical-fiber, impedimetric, or photoelectrochemical platforms with functional nanocomposites for chemical, environmental, and biosensing.

SELECTED RECENT PUBLICATIONS

- **J. Energy Chem. 2026, accepted -** Flavonoid-coordinated NiCo complex for BiVO4 solar water oxidation.
- **Appl. Surf. Sci. 2026, 741, 167133 -** Light-induced morphological and optical changes of CsPbBr3 nanocrystals.
- **J. Mater. Chem. C 2026, 14, 11318-11325 -** Optical comparison of CsPbBr3 QDs and CVD-grown microplates.
- **Mater. Today Phys. 2026, 61, 102031 -** Wavelength-dependent response in perovskite-QD/graphene photodetectors.

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REPRESENTATIVE RESEARCH FIGURES / SCHEMES

