Casey Kerr

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Research Summary

Ph.D. candidate in Physics at the University of Oklahoma specializing in epitaxial functional oxide thin films grown via Pulsed Laser Deposition (PLD). Research focuses on magneto-optical garnets, ferroelectric heterostructures, and superconducting oxides for photonic and quantum device applications. Extensive experience in thin-film growth optimization, structural characterization (XRD), and structure–property correlation in complex oxide systems.

Education

University of Oklahoma, Norman, OK
Ph.D. in Physics (In Progress) GPA: 3.86
M.S. in Physics, 2025 GPA: 3.86

University of Notre Dame, Notre Dame, IN
B.S. in Physics and Mathematics, 2023 GPA: 3.5

Research Experience

Epitaxial Growth of Rare-Earth-Doped $SrWO_4$ Thin Films for Quantum Photonics
2025–Present

- Developed epitaxial $SrWO_4$ thin films on Si(100) using YSZ/CeO_2 buffer layers via pulsed laser deposition (PLD).
- Optimized deposition temperature, oxygen pressure, and buffer layer thickness to improve crystalline quality and epitaxial alignment.
- Characterized crystal structure, epitaxial orientation, and surface morphology using XRD, rocking curves, phi scans, and AFM.
- Fabricated Er^{3+}-doped $SrWO_4$ thin films with controlled doping concentrations from 0.05% to 1%.
- Demonstrated preliminary room-temperature photoluminescence lifetimes of 4.6 ms in 1% Er-doped $SrWO_4$ films through collaborative optical measurements.
- Target application: integration of rare-earth-based quantum memories and coherent optical emitters onto silicon photonic platforms.

Growth Optimization of $YBa_2Cu_3O_{7-\delta}$ (YBCO) for Superconducting Detectors
2025–Present

- Optimized epitaxial growth of high-temperature superconducting YBCO thin films on silicon via PLD.
- Systematically varied laser repetition rate, oxygen pressure, and substrate temperature to improve phase purity.
- Evaluated structural quality via XRD and surface morphology via AFM.
- Achieved Tc above 82K
- Target application: integration into superconducting nanowire single-photon detectors (SNSPDs) and superconducting quantum interference device (SQUIDs).

Frustrated Ferroelectric HfO_2/CeO_2 Heterostructures
2025–2026

- Fabricated oxide heterostructures to induce frustrated ferroelectric behavior.
- Investigated optical Kerr rotation response in layered structures.
- Performed structural and surface characterization using XRD.

Patterned Silicon Epitaxy: Waist Formation in Oxide Micro-Pillars
2024–Present

- Studied PLD growth on lithographically patterned silicon.
- Investigated diffusion-limited growth mechanisms leading to morphological "waist" formation.
- Correlated microstructure with deposition conditions using SEM.

Epitaxial $Lu_3Fe_5O_{12}$ (LuIG) Thin Films for Magneto-Optical Applications
2023–2025

- Deposited high-quality epitaxial LuIG films using Pulsed Laser Deposition under controlled oxygen partial pressures.
- Tuned growth parameters (substrate temperature, laser fluence, oxygen background pressure) to control oxygen vacancy concentration.
- Characterized crystallinity using X-ray diffraction (θ–2θ scans, rocking curves).
- Investigated Faraday rotation and spin transport behavior in garnet films.
- Correlated oxygen vacancy concentration with magnetic and optical properties.

Technical Skills:

Thin Film Growth: Pulsed Laser Deposition (PLD)

Structural Characterization: X-ray Diffraction (θ–2θ, rocking curve analysis, XRR, RSM)

Surface & Imaging: AFM, SEM

Programming: Python, C, C++, SQL, Bash

Conference Presentations

Kerr, C., "Oxygen Vacancies in Epitaxial $Lu_3Fe_5O_{12}$ Garnet Films,"
Poster Presentation, Materials Research Society (MRS) Fall Meeting & Exhibit, Boston, MA, 2025. Symposium EL05.05.06.

Kerr, C., "Spin Transport in Epitaxial $Lu_3Fe_5O_{12}$ Garnet Films,"
Poster Presentation, Materials Research Society (MRS) Fall Meeting & Exhibit, Boston, MA, 2024. Symposium QT02.10.04.

Teaching Experience:

Graduate Teaching Assistant, University of Oklahoma 2023–Present

- Led discussion and laboratory sections for introductory physics.
- Guided students through experimental methods and data analysis.