Curriculum Vitae

Hao Chen

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Research Profile

Researcher in complex oxide thin films, specializing in defect-mediated electronic structure evolution and structure–property relationships. Experienced in thin-film growth using RF magnetron sputtering and pulsed laser deposition (PLD), combined with synchrotron-based spectroscopy techniques including XANES/EXAFS, RIXS, and operando XAS to probe local structure and electronic-state evolution. Proven expertise in synchrotron experiment design, beamtime proposal preparation, and independent beamline operation. Skilled in integrating multimodal characterization with Python-based spectroscopy workflows for mechanistic understanding of complex material systems. Experienced in multidisciplinary international research environments, with publications in peer-reviewed journals and presentations at international conferences.

Research Interests

Complex oxide thin films and heterostructures; Defect-mediated electronic structure evolution; Synchrotron-based spectroscopy; Structure–property relationships in functional materials

Education & Professional Experience

Postdoctoral Fellow – Department of Physics, Politecnico di Milano, Italy. 02/2024–11/2025
Ph.D. (con Lode) in Physics – Department of Physics, Politecnico di Milano, Italy. 11/2020–05/2024
Research Exchange – European Synchrotron Radiation Facility (ESRF), France. 09/2022–12/2022
M.Sc. in Materials Engineering and Nanotechnology – Politecnico di Milano, Italy. 09/2017–07/2020
B.Sc. in Materials Science and Engineering – Henan Polytechnic University, China. 09/2013–06/2017

Synchrotron Radiation Experience

- **XANES/EXAFS (ESRF)**: Designed and independently executed experiments to probe defect-driven local structure–property relationships in complex oxides.
- **RIXS (ESRF)**: Contributed to beamtime proposal preparation and carried out experiments, focusing on electronic excitation processes in correlated oxide systems.
- **Operando XAS (Elettra)**: Performed in situ experiments to decouple thermal and chemical effects governing electronic and local structural evolution under working conditions.

Representative Research Projects

Defect-Mediated Electronic Structure Engineering in WO_{3-x} Thin Films

- Engineered oxygen-vacancy-controlled WO_{3-x} thin films via RF magnetron sputtering and post-growth treatments to tune optoelectronic properties.
- Established correlations between defect chemistry, amorphous-to-crystalline transition, and charge-transport/optical behaviors through multimodal structural and spectroscopic characterization.
- Developed a depth-gradient ellipsometry model enabling continuous dielectric function profiling beyond conventional homogeneous-layer approximations.
- Probed defect-dependent local coordination and electronic structure evolution using synchrotron XANES/EXAFS spectroscopy.
- Developed automated Python-based RIXS workflows incorporating non-negative matrix factorization (NNMF) for hidden-excitation analysis and structure–property correlation.
- Studied photoexcited carrier dynamics and defect-state coupling using transient absorption spectroscopy.

Interface and Structural Control in Oxide Heterostructures

- Optimized PLD epitaxy for interface, structual-phase and compositional control in $SrO/SrIrO_3$ superlattices and high-entropy oxide thin films.

- Extracted epitaxial quality, interface sharpness, and superlattice periodicity from XRD and XRR, providing a quantitative assessment of structural quality.
- Investigated chemical homogeneity and electronic states using XPS and EDXS to support structural and compositional optimization in complex oxide thin films.

Operando Spectroscopy of Functional Oxide Materials

- Performed operando XAS studies of SOFC cathode materials to probe electronic structure evolution under working conditions.
- Developed Python-based workflows for distinguishing thermally and chemically induced spectral evolution.

Computational & Analytical Skills

- XAS modeling and local structure analysis (Athena/Artemis).
- Data processing and visualization (OriginPro).
- Python-based spectroscopy workflow development and scientific computing.
- Multimodal spectroscopy and structural data analysis.

Languages

English: professional proficiency. **Italian**: basic working proficiency. **Chinese**: native.

Publications & Academic Activities

- Author/co-author of 6 peer-reviewed journal publications, including 2 first-author papers on defect engineering in WO_{3-x} thin films for optical/electronic modulation, combined with spectroscopy and modeling.
- Presented research at international conferences in synchrotron spectroscopy and functional oxide materials.
- Ongoing work includes RIXS/XAS analysis, defect-driven electronic structure evolution, and ultrafast carrier–defect interactions.

Publications

Peer-Reviewed Journal Articles (First-author)

1. Depth-resolved dielectric function analysis of oxygen-deficient WO_{3-x} thin films via graded Ellipsometric modeling, AIP advances, accepted (2026).
2. Tungsten oxide films by radio-frequency magnetron sputtering for near-infrared photonics, Optical Materials: X, 12, 100093 (2021).

Conference Proceedings (First-author)

1. Amorphous WO_3 as transparent conductive oxide in the near-IR, Proc. SPIE Europe, 12142, 121421J (2022).
2. Near-IR transparent conductive amorphous tungsten oxide thin layers by non-reactive radio-frequency magnetron sputtering, EPJ Web Conf., 255, 05003 (2021).

Conference Contributions

Oral Presentations

1. XAS and RIXS investigation of oxygen vacancy engineering in WO_{3-x} films: from amorphous to crystalline phases, FISMAT, July 2025, Venice, Italy.
2. Effect of annealing in air, N_2 and vacuum on the structure of RF-sputtered tungsten oxide thin films, CMD30-FISMAT, September 2023, Milan, Italy.
3. Tailorable WO_3 for near-IR photonics and transparent-conductive films, 108° Congresso Nazionale, SIF, September 2022, Milan, Italy.
4. Near-IR transparent conductive amorphous tungsten oxide thin layers by non-reactive radio-frequency magnetron sputtering, EOSAM, September 2021, Rome, Italy.

Poster Presentations

1. Local structure of amorphous and crystalline WO_{3-x} thin films studied by XANES and EXAFS, ESRF user meeting, February 2024, Grenoble, France.
2. Amorphous WO_3 as transparent conductive oxide in the near-IR, SPIE photonics Europe, April 2022, Strasbourg, France.