

Hugh Littlehailes, PhD

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Personal statement

A highly motivated and technically skilled professional, with 6 years of nanofabrication, materials development, and advanced data analysis experience, from both academia and industry. Recent PhD graduate from both Queen's University Belfast and the University of Glasgow, with the publications of a thesis and two high impact papers. Proficient in a wide range of process, analytical, and programming skills; looking to secure a challenging, problem-solving position to utilise and grow my expertise as a physicist and engineer in the development and management of new technologies with positive real-world impact.

Education

- 2023 **PhD, Physics (Photonic integration and advanced data storage),**
University of Glasgow | Queen's University Belfast,
Thesis title: "Alternative plasmonic materials and techniques for high temperature application and beyond"
- 2019 **PGCert in Innovation and Entrepreneurship,**
Trinity College Dublin | University College Dublin | Queen's University of Belfast
- 2017 **BSc Hons, Physics with Astrophysics, 2:1,**
University of Glasgow

Experience

- Apr. 2023 – **Post-doctoral research associate, The University of Sheffield, Sheffield**
Aug. 2024, (FTC)
- Senior researcher in a 5-university consortium investigating sensor-fusion frameworks for advanced manufacturing techniques.
 - Developed a novel sensor-framework for in-situ monitoring of air-plasma spray coating; designed and led performance experiments.
 - Analysed diverse datasets in python to establish fundamental factors affecting manufactured layer quality for lifetime improvement, validated by post-process SEM cross-section analysis.
 - Applied Machine-Learning for diagnostic insights and linked key process input and output variables, reaching key milestones, during contract term.
- Advisor : **Prof. Ashutosh Tiwari**, Airbus / RAEng Research Chair in Digitisation for Manufacturing, University of Sheffield
- Jan. 2022 – **Thin-film scientist, Seagate Technology, Derry/Londonderry, Northern Ireland**
Apr. 2023
- Senior process engineer and owner of ion-beam etch and sputter deposition wafer processing, process control, and improvement of critical components across product-build lifetime.
 - Trained in six-sigma principles, statistical process control, Failure Modes Effects Analysis, as well as 8D problem solving methodologies.
 - Seconded responsibilities for assisting the integration of highest priority R&D photonic heat-assisted magnetic recording (HAMR) hard drive components and manufacturing processes.
 - Liaised with manufacturing teams to align targets with process capabilities to meet product performance requirements.
 - Trained new engineers and documented standard operating procedures.
 - Co-ordinated and drove weekly defect and yield group meetings. Regular international collaboration and updates with factory team and other international factory sites to ensure congruent performance metrics.

Research Experience

Fabrication of alternative Au NFTs for investigation with STEM-EELS, PhD research

- Design and validation of plasmonic near-field transducers, on silicon nitride membranes, for integration in HAMR hard-drives.
- Devices designed in **L-edit** and made by **electron beam lithography** and **evaporation deposition**.
- Optical performance investigated by **Lumerical** simulations and BEM simulations in **MATLAB**.
- Experimental validation by **STEM-EELS**, demonstrating improvement on conventional designs and evidence of plasmonic intra-coupling within devices, and between adjacent structures.
- Resonance modes resolved by R-L deconvolution and non-negative matrix factorisation in **Python**.

Advisor : **Prof. Donald MacLaren**, Professor of Materials Physics (Physics & Astronomy), University of Glasgow

Fabrication and characterisation of thin films of Au₃X (X=Hf, Zr), PhD research

- Exploration of Au-Hf and Au-Zr system thin films as potential refractory plasmonic materials.
- Demonstrated first successful fabrication by **DC magnetron sputtering**.
- Extensively characterised the structural and optical properties by **XRR, XRD, spectroscopic ellipsometry, optical spectroscopy, SEM-EDX, and AFM**; publishing results.

Advisor : **Dr. Fumin Huang**, Senior Lecturer (School of Mathematics and Physics), Queen's University Belfast

Sodium as a plasmonic NFT for HAMR, PhD research

- Theoretical investigation of the suitability of elemental sodium as a plasmonic near-field transducer material for application in HAMR hard-drives by metallic nanoparticle boundary element method (MNPBEM) numerical simulations in **MATLAB**, incorporating the effect of encapsulating materials on plasmonic resonance.

Advisor : **Prof. Donald MacLaren**, Professor of Materials Physics (Physics & Astronomy), University of Glasgow

Synthesis of plasmonic materials by pulsed DC magnetron sputtering, MRes project

- Investigation into the efficacy of **pulsed-DC magnetron sputtering** (Sparc-LE) in the deposition of TiN thin films, compared to continuous DC, with variation in deposition rate, frequency, nitrogen flow rate, and sputtering power.
- Success was quantified by the reduction in optical losses, determined from analysis by **spectroscopic ellipsometry**, and the improvement in electrical conductivity.

Advisor : **Prof. Robert Bowman**, School of Mathematics and Physics, Queen's University Belfast

Measuring femtosecond pulses, MRes project

- I built the experimental set-up to generate and characterise femtosecond pulses.
- The second harmonic of a 1560 nm laser was generated using a beta barium borate non-linear crystal and the intensity and duration of both were resolved; comparing results to laser manufacturer specifications.
- The phase of the 780 nm pulse was determined using the frequency-resolved optical gating (FROG) method.

Advisor : **Prof. Matteo Clerici**, School of Engineering, University of Glasgow

Publications

Journal Articles

- 2022 **Littlehailes, H., et al.**, "Optical properties of Au-Hf thin films"(2022), *Journal of Alloys and Compounds* **912** 165127 <https://doi.org/10.1016/j.jallcom.2022.165127>
- 2021 **Littlehailes, H., et al.**, "Searching for refractory plasmonic materials: The structural and optical properties of Au₃Zr intermetallic thin films" (2021), *Journal of Alloys and Compounds* **891** 161930 <https://doi.org/10.1016/j.jallcom.2021.161930>

Talks and presentations

- June 2021 **The structural and optical properties of Au₃X (X = Hf, Zr) intermetallic thin films**, *Conference presentation at Photonics Ireland 2021, Dublin, Ireland*
- June 2019 **The optical properties of AuZr intermetallics**, *Poster presentation at the 2019 Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, Munich, Germany*

Skills

Languages: SQL, Python (Pandas/Numpy/Sci-kit learn/Matplotlib), MATLAB, LabVIEW, Arduino

Process skills: • Thin film deposition:

- o Magnetron Sputtering
- o Electron beam evaporation

• X-ray diffractometry • Energy dispersive X-ray spectroscopy

• Spectroscopic ellipsometry • Reflection spectroscopy

• Atomic force microscopy • Electron beam lithography

• Scanning electron microscopy, • Transmission electron microscopy

• Electron energy loss spectroscopy • ISO 5 cleanroom training

• Wet-etch • Dry-etch

Software skills: Ansys (Workbench, Mechanical, Lumerical), Tanner L-edit, SolidWorks, JMP Pro, Microsoft Office