Thomas James Broomhall

Email: thomas.j.broomhall@gmail.com | Telephone: +44 7523 218 942

PERSONAL STATEMENT

A committed and aspiring researcher whose PhD experiences have developed key skills for both physics and material science engineering, building upon a strong chemistry foundation. I am highly motivated in driving forward both team-based and personal research, with significant expertise in the development of new instrumentation and analytical processes. I am a confident presenter and tutor with the ability to impart complex information and disseminate key points to audiences of all levels and differing academic backgrounds. Seeking new research potentials.

RESEARCH-BASED SKILLS

Modelling and Simulations: Finite Difference methods (OOMMF, Mumax3), Atomistic (VAMPIRE, GULP), Computer Aided Design for component design and systems planning (Autodesk, SolidWorks, SketchUp).

Systems Development: Fabrication of Vector-Network Analyzer Ferromagnetic Resonance Spectrometer; Design of radio frequency waveguides and resonators; Control and Automation of electronic components and data collection (LabVIEW, MATLAB); Design of pumped optical

Sample Fabrication: Electron beam and photo lithography; Thermal evaporation and DC Magneton sputtering; Wire bonding; Practical knowledge of Organic Synthesis and Structure

Physical Analysis Methods: Atomic Force Microscopy and Magnetic Force Microscopy; Scanning Electron Microscopy; Magneto-Optic Kerr Effect magnetometry; Ferromagnetic Resonance Measurements; X-ray and Neutron diffraction using specular and off-specular measurement methods; X-ray transmission magnetic imaging; XRD, NMR, ICP, GC, Mass-Spec, UV / Vis and IR Spectroscopy for structure determination.

Data Analysis: Analytical and experimental model fitting, including signal processing (Python, MATLAB); Data processing and graphical presentation (OriginPro).

PUBLICATIONS AND PRESENTATIONS

"Harnessing Emergent Dynamics in a Nanomagnetic System for Reservoir Computing",
R. W. Dawidek, T. J. Hayward, I. T. Vidamour, T. J. Broomhall, D. A. Allwood *et al*. Submitted to Scientific Advances 2020.

"Suppression of Dynamically Induced Stochastic Magnetic Behaviour through Materials Engineering"
T. J. Broomhall, A. W. Rushforth, M. C. Rosamond, E. Linfied, T. J. Hayward. Physical Review Applied 13(2)

"Toward Chirality-Encoded Domain Wall Logic",
K. A. Omari, T. J. Broomhall, T. J. Hayward *et al*. Advanced Functional Materials, 29(10), 1807282.

"Suppression of Stochastic Domain Wall Pinning Through Control of Gilbert Damping",
T. J. Broomhall, T. J. Hayward, Scientific Reports, 7(1), 17100.

"Ballistic rectification of vortex domain wall chirality at nanowire corners",
K. A. Omari, R. C. Bradley, T. J. Broomhall, T. J. Hayward *et al*, Appl. Phys. Lett., vol. 107, no. 22, 2015.

"Micromagnetic Simulations of Domain Wall States and Dynamics in Rare-Earth Doped NiFe Nanowires."
T. J. Broomhall, T. J. Hayward, Magnetism 2015

"Suppression of Stochastic Domain Wall Pinning Through Modified Gilbert Damping In Permalloy Nanowires."
T. J. Broomhall, T. J. Hayward Exeter School of Magnonics 2016

"Magnetism you can rely on: A materials-science based solution to stochastic domain wall pinning in magnetic nanowire devices",
T. J. Broomhall, P. W. Fry, M. C. Rosamond, A. W. Rushforth, D. A. Allwood, TJ Hayward, Magnetism 2018

"Emergent Behaviour in Interconnected Nanoring Arrays."
R. W. Dawidek, T. J. Hayward, T. J. Broomhall, M. Negoita, M. Mamoori, P.W. Fry, J. Cooper, N. Steinke and D. A. Allwood, MMM 2017

EMPLOYMENT HISTORY

October 2018 – January 2020
Research Associate in Magnetic Resonance of Semiconductor Quantum Dots | University of Sheffield, Sheffield, UK

Key responsibilities included low temperature optical and magnetic measurements on semiconductor quantum dots, the maintenance of laboratory infrastructure and development of experimental methods. Fabrication and analysis of quantum dot structures including optical methods, electron-microscopy, and deposition techniques in a cleanroom environment.

Development of new experimental systems involved microwave induced magnetic resonance via optical detection, including design, validation and testing of PCB mounted resonators and optical detection systems. Development of experimental components for cryostat usage via CAD designs.

October 2017
Consultant Scientist | University of Sheffield, Sheffield, UK

Consultant scientist for delivering research outcomes for an external company on short turn arounds.

November 2013 – December 2016
Graduate Teaching Assistant | University of Sheffield, Sheffield, UK

Facilitating small group learning for undergraduate lab sessions and facilitating problem sessions for magnetic MSc courses.

EDUCATION

09/2013 – 06/2018
University of Sheffield | Sheffield, UK
PhD: Materials Science and Engineering
Topic: Suppression of stochastic domain wall motion through modified Gilbert damping by rare earth doping of $Ni_{80}Fe_{20}$ thin films.

My Research involved development of new measurement system (Vector Network Analyzer - Ferromagnetic resonance), including coding (LabVIEW) and data fitting models (MATLAB, Python) for different measurement types to extract magnetic susceptibilities. Simulation of magnetic domain walls within nanostructures (OOMMF and Mumax3) with a focus on the ground states and propagation behaviours of domain walls. Fabrication of nanostructures using different lithography (Photo-, EBL) techniques and deposition methods (Evaporation, Sputtering). Use of Focussed magneto-optic Kerr effect for measurement of stochastics in single nanowires, and MOKE of thin films. Usage of X-ray transmission magnetic imaging (ALS) and polarised neutron diffraction (ISIS STFC) and scattering at centralised facilities.

Key research outcomes have found and defined the different in magnetic ground states in nanostructures made of Ni80Fe20 with different levels of rare earth dopants. Investigation of the propagation of domain wall ground states have shown an increased stability in dynamic behaviour due to increased damping, arising from rare earth dopants. The resulting stability gives rise to a suppression of stochastic responses of a domain wall for potential domain wall nanostructure devices.

09/2009 – 06/2013
Keele University | Keele, UK
BSc: Chemistry with Forensic Science (2:1)
Dissertation: On the morphology of zirconium crystals from fluorinated hydrothermal synthesis.

My research focussed on the hydrothermal synthesis of zirconium, and analysis of the resulting crystal morphology with varying synthetic conditions. Wet bench approaches to synthesis were employed, with analysis of the resulting crystalline products being analysed by SEM, XRD and FTIR methods. Structural information was then used to generate atomistic models using GULP to identify the differences in structure than can cause changes in morphology.

Modules studied included: Electrons in Atoms and Molecules, Organic Synthesis and Chirality, The Physical Basis of Chemical Processes, Spectroscopy and Advanced Analysis, Biologically Important Molecules, Physical Chemistry, Solids, Surfaces and Catalysis, Making Organic Molecules, Organometallic and the f-Block, Advanced Chemical Analysis, Spectroscopic Methods and Synthesis Kinetics & Mechanisms