

Seminar presented by **Professor Russell Cowburn - IEEE distinguished Lecturer 2015**

Local: Instituto Superior Técnico, Lisbon - (room PA1-Physics building)

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**UNIVERSITY OF  
CAMBRIDGE**  
Cavendish Laboratory



### **Perpendicular magnetic anisotropy: from ultralow power spintronics to cancer therapy**

Most thin magnetic films have their magnetization lying in the plane of the film because of shape anisotropy. In recent years there has been a resurgence of interest in thin magnetic films which exhibit a magnetization easy axis along the surface normal due to so-called Perpendicular Magnetic Anisotropy (PMA). PMA has its origins in the symmetry breaking which occurs at surfaces and interfaces and can be strong enough to dominate the magnetic properties of some material systems. In this talk I explain the physics of such materials and show how the magnetic properties associated with PMA are often very well suited to applications. I show three different examples of real and potential applications of PMA materials: ultralow power STT-MRAM memory devices for green computing, 3-dimensional magnetic logic structures and a novel cancer therapy.

### **Key Publications**

- "Magnetic ratchet for three-dimensional spintronic memory and logic", Nature 493, 647 (2013)
- "Dynamic Oscillations of Coupled Domain Walls", Phys. Rev. Lett. 108, 187202 (2012)
- "Tunable Remote Pinning of Domain Walls in Magnetic Nanowires", Phys. Rev. Lett. 106, 087204 (2011)
- "Near-field interaction between domain walls in adjacent permalloy nanowires", Phys. Rev. Lett. 103, 077206 (2009)
- "Measuring domain wall fidelity lengths using a chirality filter", Phys. Rev. Lett. 102, 057209 (2009)
- "High efficiency domain wall gate in ferromagnetic nanowires", Appl. Phys. Lett. 93, 163108 (2008)
- "Fingerprinting' documents and packaging", Nature 436, 475 (2005)
- "Magnetic domain wall logic", Science 309, 1688-1692 (2005)
- "Submicrometer ferromagnetic NOT gate and shift register", Science 296, 2003-2006 (2002)
- "Room temperature magnetic quantum cellular automata", Science 287, 1466-1468 (2000)
- "Single domain circular nanomagnets", Phys. Rev. Lett. 83, 1042-1045 (1999)

### **Biography**

Russell Cowburn has research interests in nanotechnology and its application to magnetism, electronics and optics. Before returning to Cambridge in 2010 he held positions at the CNRS Paris, University of Durham and Imperial College London. He is the founder of two start-up companies and the inventor of the anti-counterfeiting technology 'Laser Surface Authentication'. He has had over 60 patents granted and is a frequent invited speaker at international conferences. He is the winner of the GSK Westminster Medal and Prize, the Degussa Science to Business Award, the Hermes International Technology Award and the Institute of Physics Paterson Medal and Prize. He is a Fellow of the Royal Society.