

The Royal Academy  
of Engineering

## Research Fellowship

### Engineering Information Storage Devices through Material Structure

Co-funded by EPSRC

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#### Introduction

- **Information Storage Devices:** Interaction of electron spin and magnetic properties of materials.  
**Applications:** Non-volatile memory, Added control parameter to transistors ('spin-electronics').  
**Fabrication:** Requires engineering the structure of thin films and interfaces at the atomic scale.
- **Aim:** Control magneto-transport properties of these devices through the material structure.  
**Experimental:** Emphasis on transmission electron microscopy (TEM).

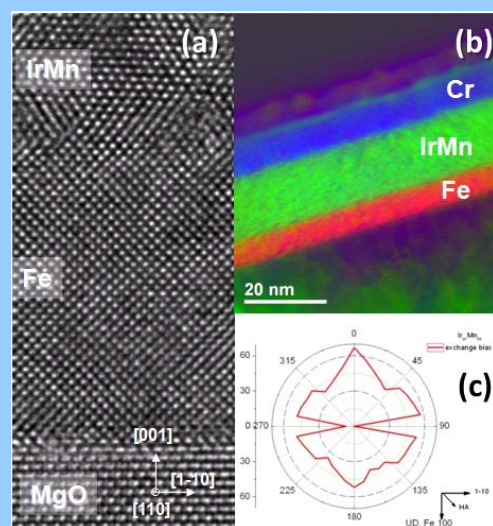
#### Examples

##### Exchange-bias ↔ Epitaxial bilayers

Ferromagnetic / Antiferromagnetic bilayers are components in sensors and magnetoresistive random access memory.

Magnetic coupling at the interface results in pinning of moments, which is used as a reference state for the device.

Epitaxial structures of Fe / IrMn are model systems for studying the physics of exchange-bias.



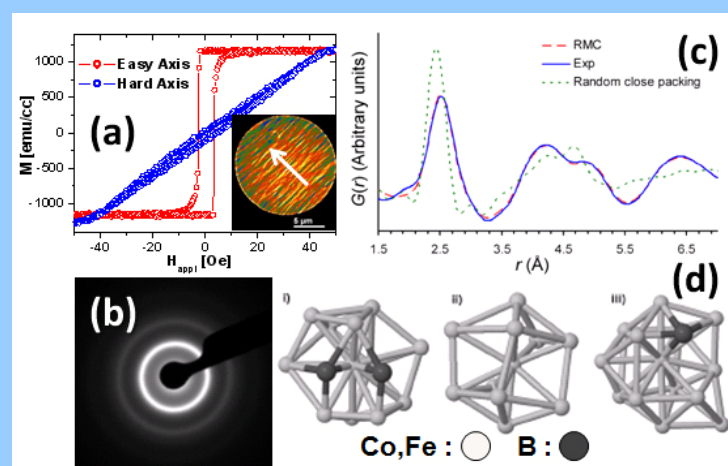
*Phys. Rev. B* **78**, 180411 (2008)

##### Anisotropy ↔ Amorphous Ferromagnet

Amorphous ferromagnets (CoFeB) are used as electrodes in information storage devices.

For operation, anisotropy is induced by magnetic annealing even though the structure is amorphous.

Subtle rearrangement of short range order may be the structural source for induced anisotropy.



*Phys. Rev. B* **79**, 014203 (2009)

#### Conclusion

- Controlling the structure of magnetic materials is required for developing information storage devices.
- Transmission electron microscopy is an important tool for characterising the structure, chemistry and magnetic properties at the nanometre scale.