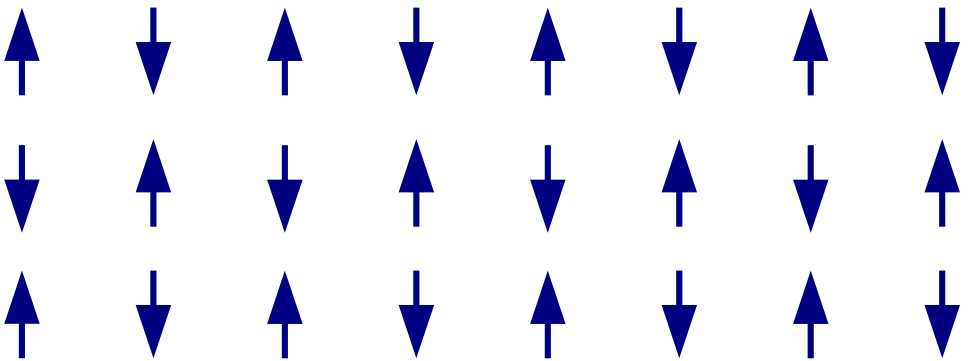
Antiferromagnetic Spintronics

and its uses in storage media

Antiferromagnetic Spintronics

- Regular pattern of magnetic moments such that neighbouring spins oppose and cancel out overall.
- Unaffected by external magnetic fields.

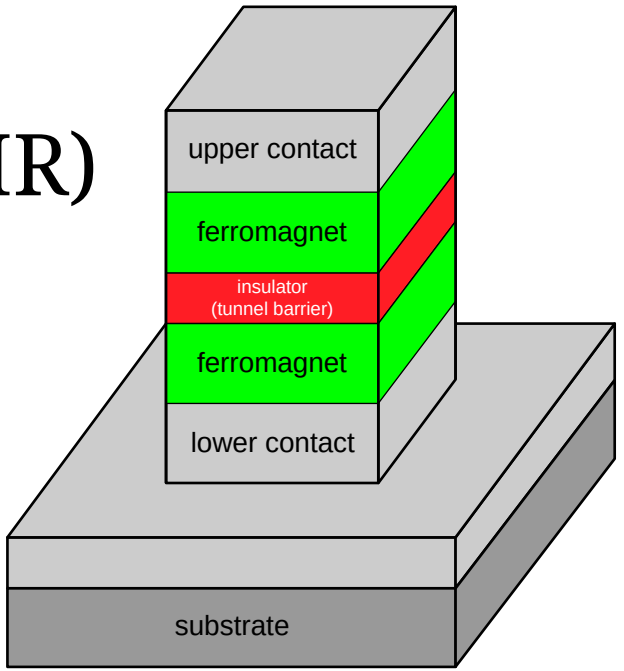


Antiferromagnetic Spintronics

- Spin transport electronics.
- Spin is the innate angular momentum of an electron.
- Gives an additional degree of freedom over just charge; useful for data storage and transfer.

Spintronics in Hard Drives

- Spintronics used in read heads of hard drives.
- Tunnel magnetoresistance (TMR)
- No antiferromagnetics...



SRAM

- Transistor flip-flop logic gate.
- Very fast (~1ns)
- Problems with density and power
- Used in CPU caches.

DRAM

- Capacitor-transistor based.
- Much slower (~10ns)
- Can be made densely.
- Used in modern computer RAM.

Magnetoresistive RAM

- Very fast memory based upon storing data in the spin alignments of electrons.
- Non-volatile, so much lower power.
- Currently based on ferromagnets; has issues with stray fields/interferance.
- Fundamentally the same tech as magnetic core memory.

Antiferromagnetics to the rescue!

- Unaffected by stray fields (tested up to 9T!)
- Cells therefore don’t interfere with each other.
- Much faster switching, allowing picosecond operation rather than nanosecond.
- *Just one small problem… We can’t read it!*

Spin-transfer torque

- Uses spin polarised currents to exchange angular momentum with the electrons to measure them.
- Common technique for cutting edge MRAM.
- Spin-orbit-torque potentially better, but experimental currently.

Thank you for listening!

Slides: frost.cx/2022/afm-spintronics.pdf

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Sources last retrieved 2022-02-24