

Nano-Spintronics

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In almost 10 years time, current nanoelectronic technologies will hit physical limitation, which does not allow us to miniaturise devices further. We therefore need to utilise an electron spin orientation to include extra information in an electron as a data carrier, leading to a new research field of spintronics. Spintronics is a new emerging field based on a combination of three conventional information carriers; electron charges, electron spins and photons. These carriers represent three major fields in information technology; data processing with electron transport, data storage with an assembly of spins and data transfer via optical connections.

In order to achieve highly efficient spin injection into a semiconductor, interfacial atomic structures of epitaxial Fe/GaAs (001) films have been investigated using high resolution transmission electron microscopy. We found Schottky barrier distributions in the interface and correlated to transport properties. We also estimated spin life time by measuring a spin-polarized current using the Hanle effect in a three-terminal device.

We also observed a crystallisation process in polycrystalline Co-based Heusler alloy films, revealing the layer-by-layer ordering. Such a process leads to nanocrystallites with the size up to a few 100 nm, which can be effectively exchange-biased using a neighbouring antiferromagnetic layer. These findings are very useful for future implementation of such a half-metallic film into a device.

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