

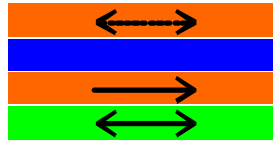
Spintronics in Novel Systems

MINT Spring review 2003

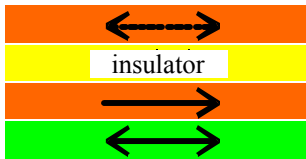
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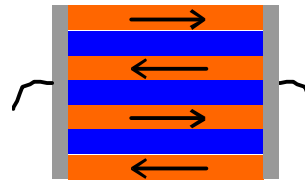
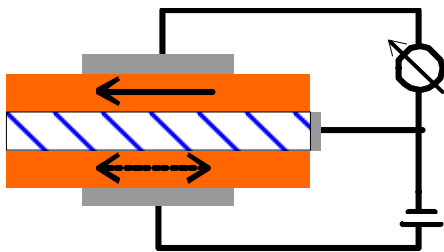
Spin-dependent transport materials



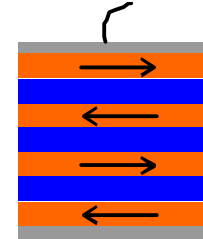
spin valve



magn. tunnel junction



CIP

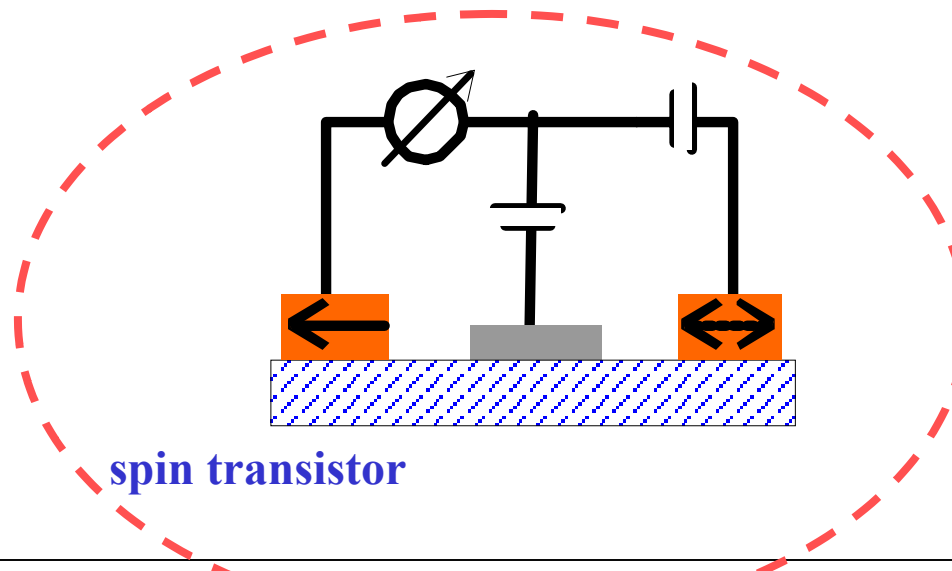


CPP

GMR multilayer



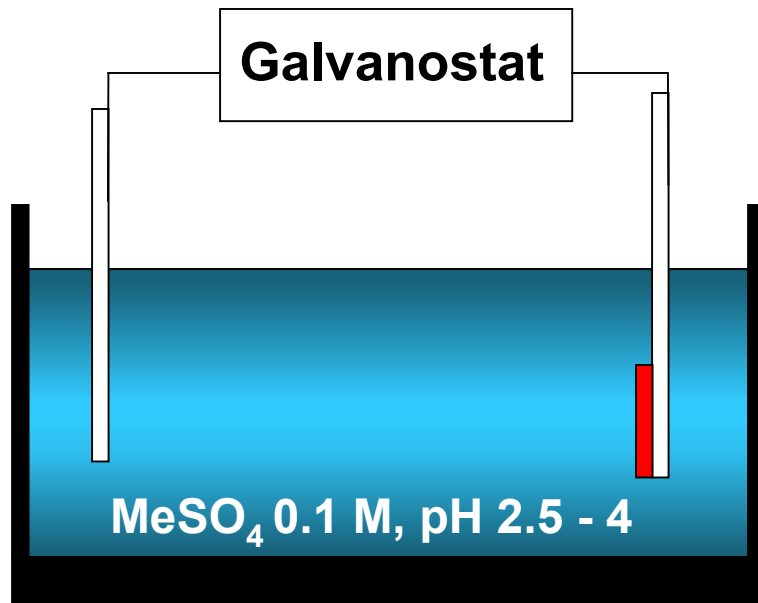
domain wall resistance



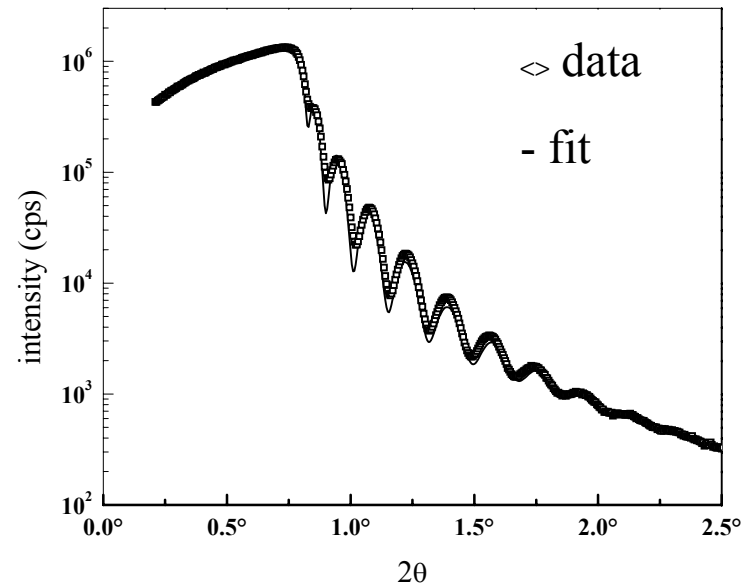
spin transistor

Electrodeposited Ni, Co, Fe on GaAs

Experimental



Thickness calibration



smooth layers

Growth

- n-GaAs (001), (011) - 10^{17} cm⁻³ Te
- Back contact: Ga/In eutectic
- Graphite counter electrode
- EG&G 273A Galvanostat
- Room Temperature

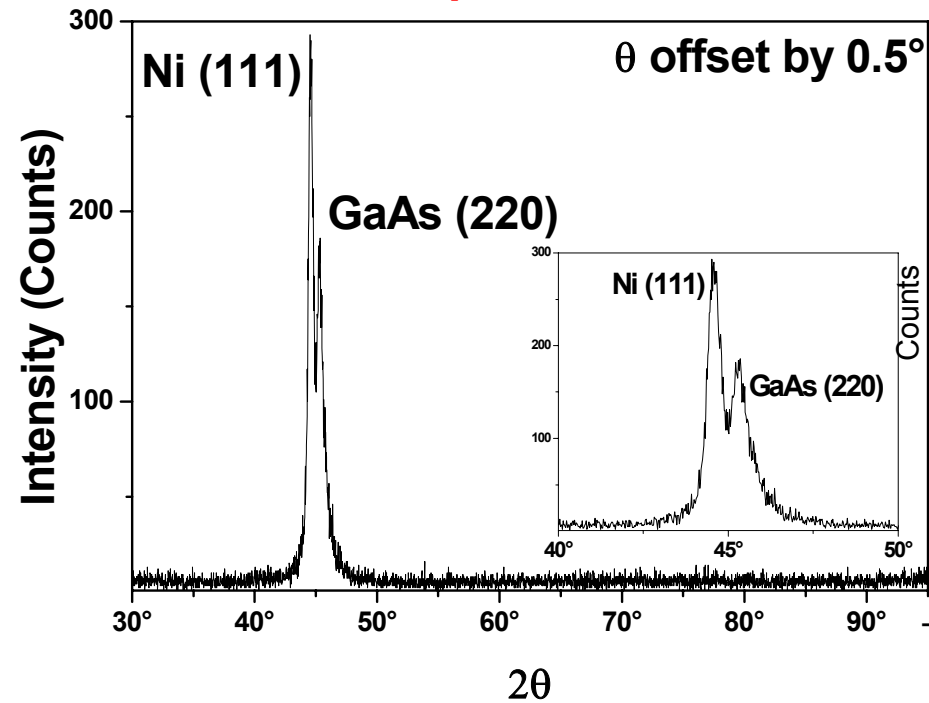
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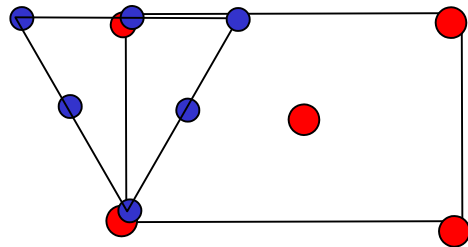
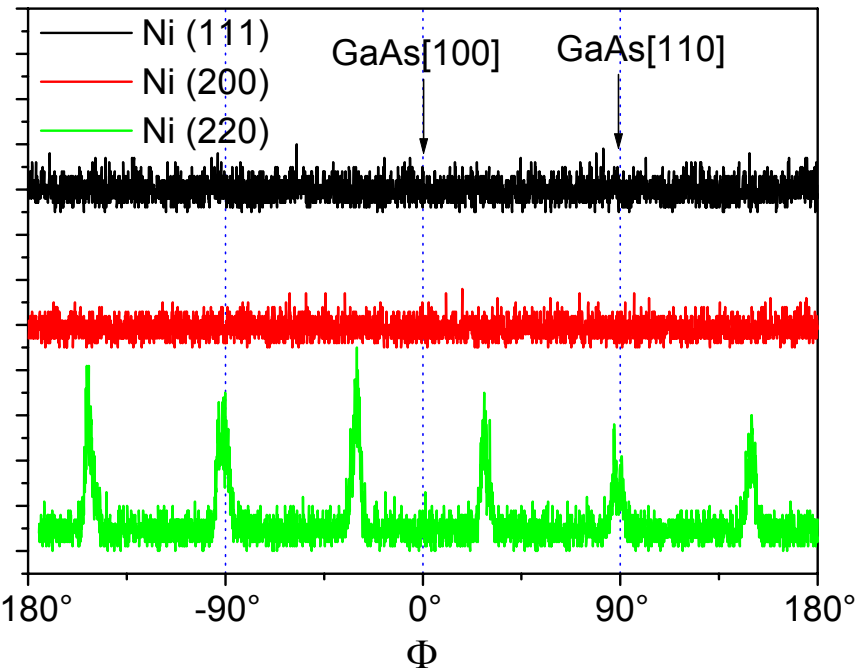
Electrodeposited Ni, Co, Fe on GaAs

Crystalline Structure (XRD) - Ni on GaAs (011)

Out of plane:



In Plane:

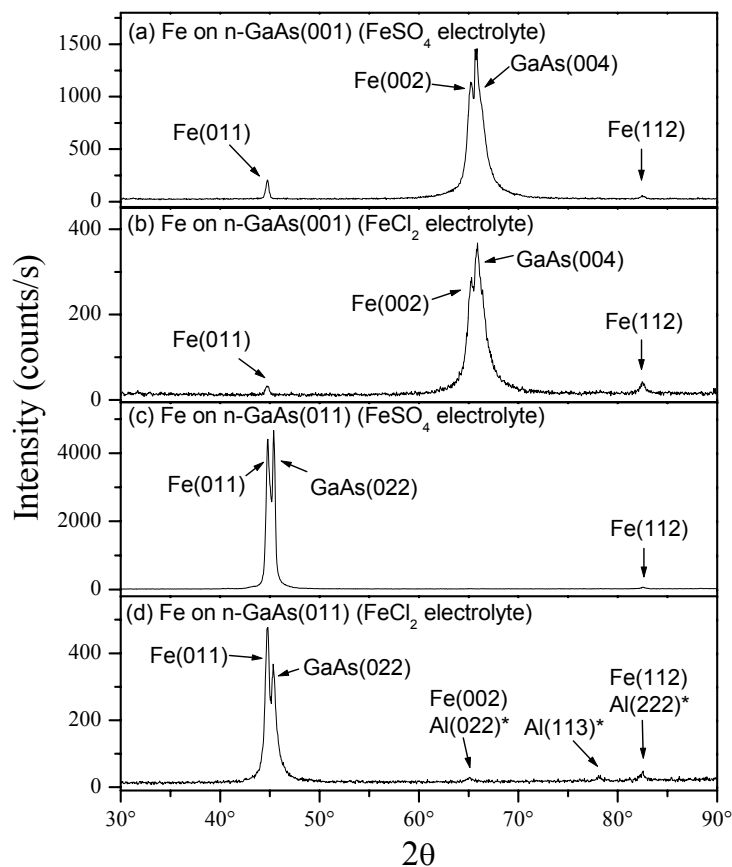


Ni(111)//GaAs(011)
Ni[110]//GaAs[110]

Electrodeposited Ni, Co, Fe on GaAs

Crystalline Structure (XRD) - Fe on GaAs (001),(011)

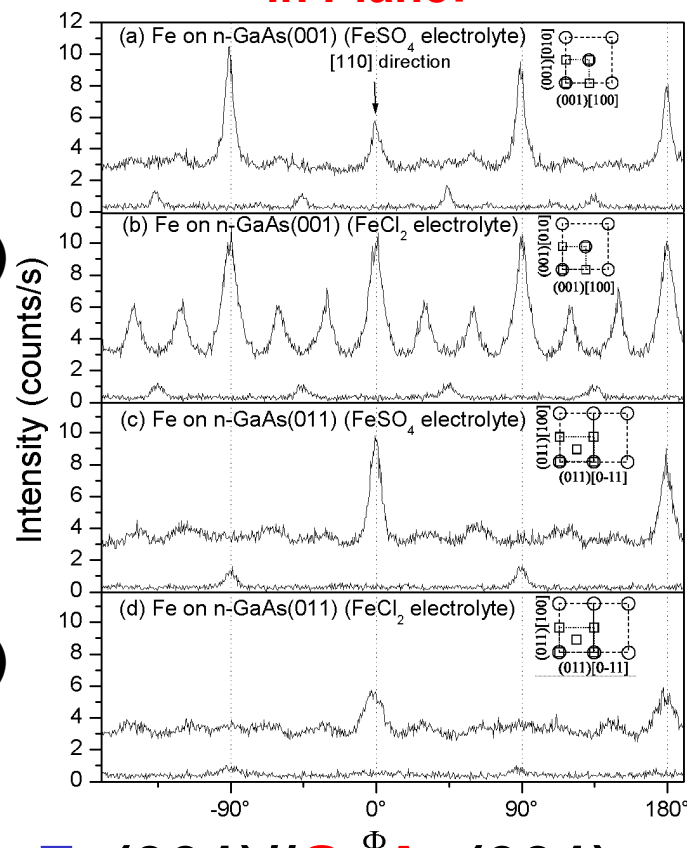
Out of plane:



**Fe(001)/
GaAs(001)**

**Fe(011)/
GaAs(011)**

In Plane:

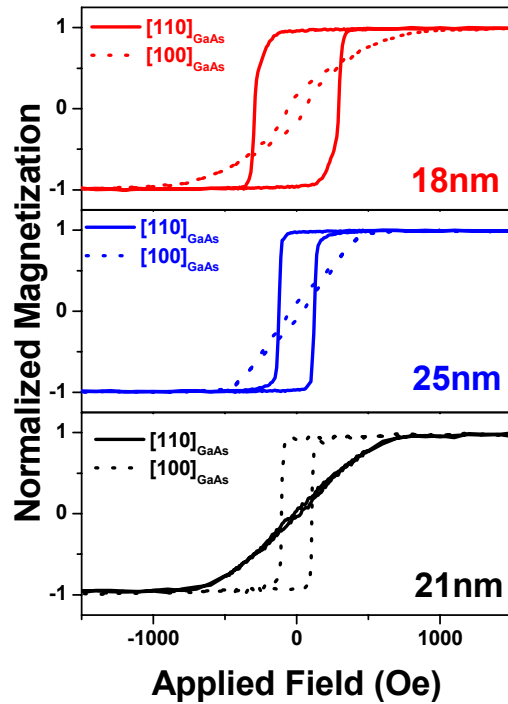


**Fe(001)//GaAs(001)
Fe[010]//GaAs[010]**

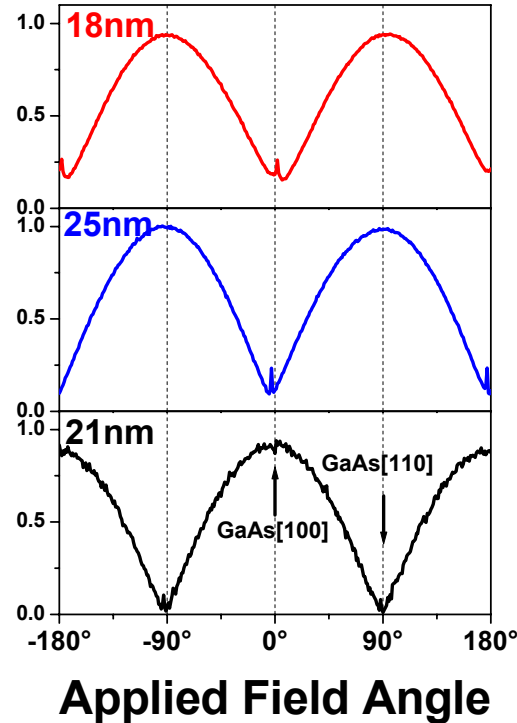
Electrodeposited Ni, Co, Fe on GaAs

Magnetic Properties

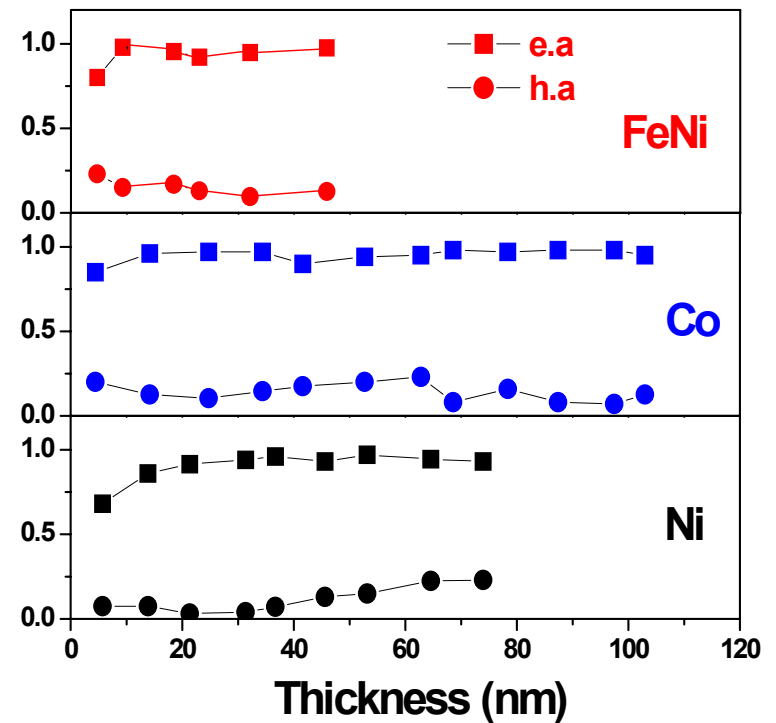
Hysteresis



Remanence



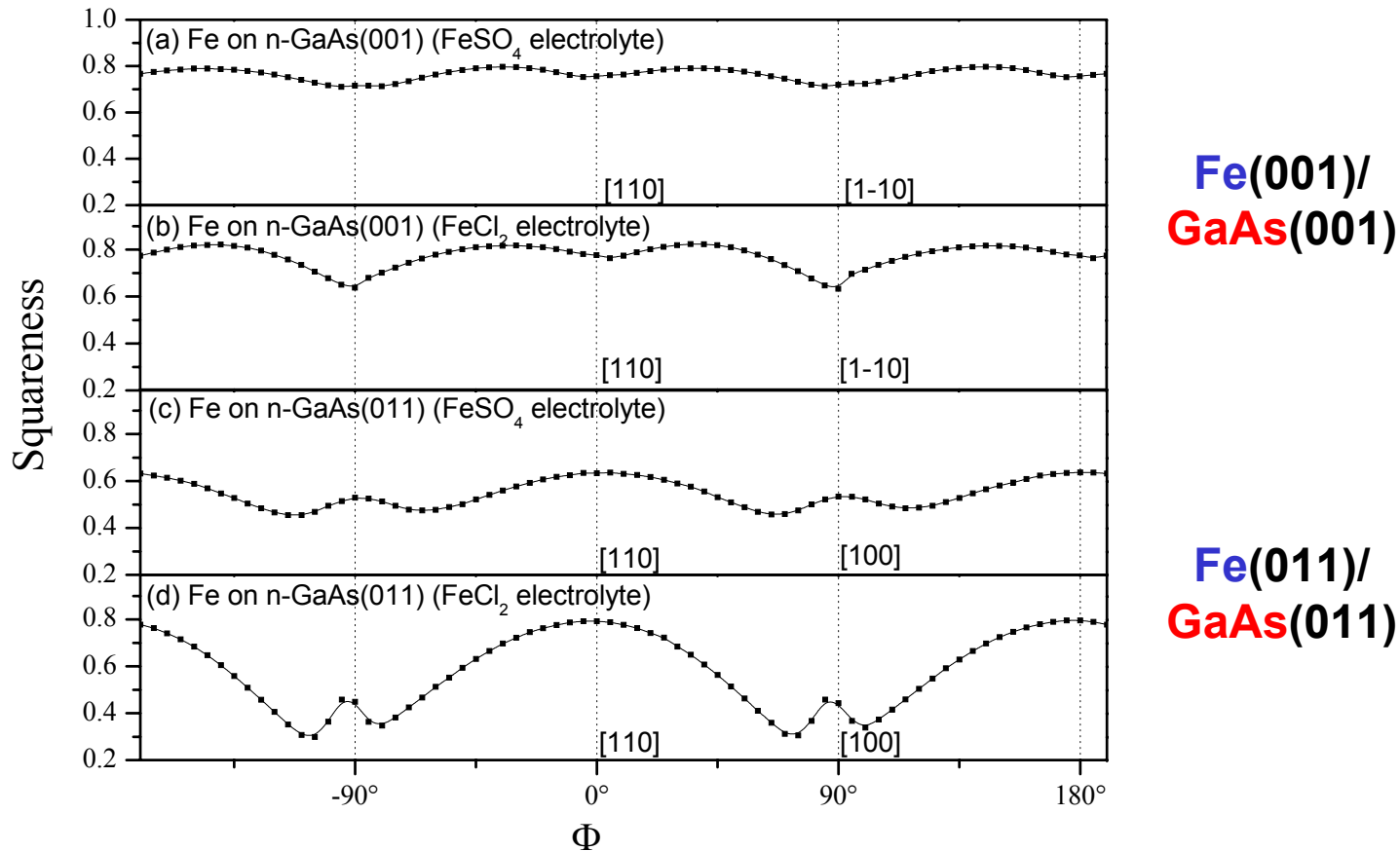
Squareness



Uniaxial anisotropy → e.a [001]_{GaAs} for Ni
 → e.a [011]_{GaAs} for Co and FeNi

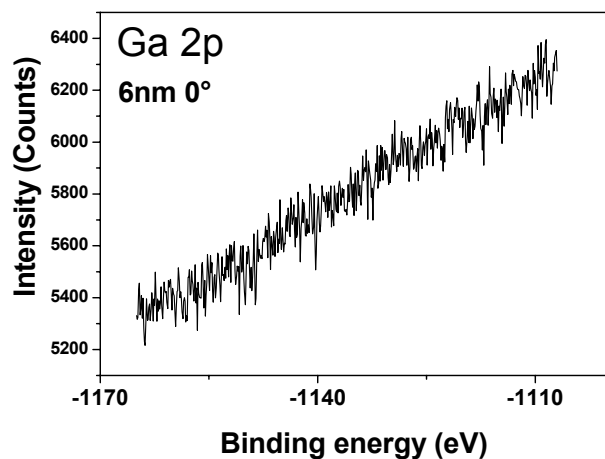
Electrodeposited Fe on GaAs Magnetic Properties epitaxial Fe

Remanence

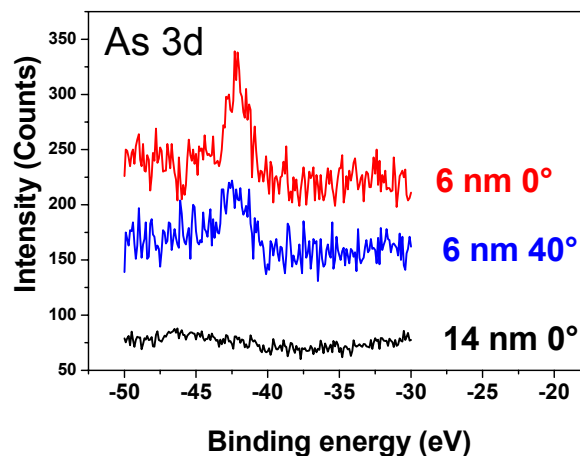


Electrodeposited Ni, Co, Fe on GaAs

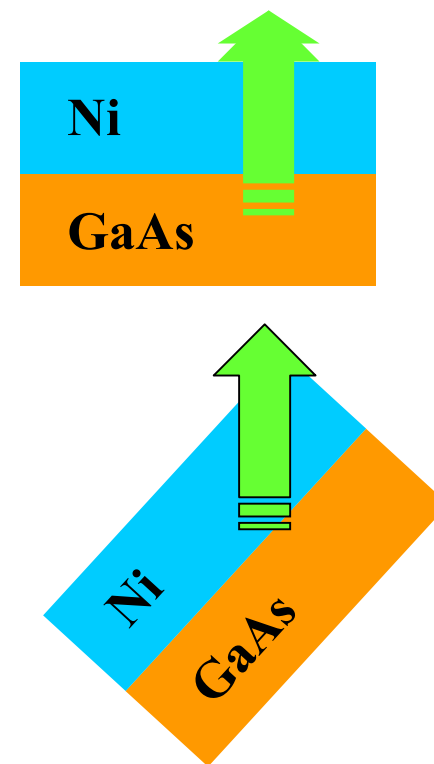
Interface intermixing: XPS analysis



mfp @ 370eV(Ga 2p)
in Ni = 0.75nm

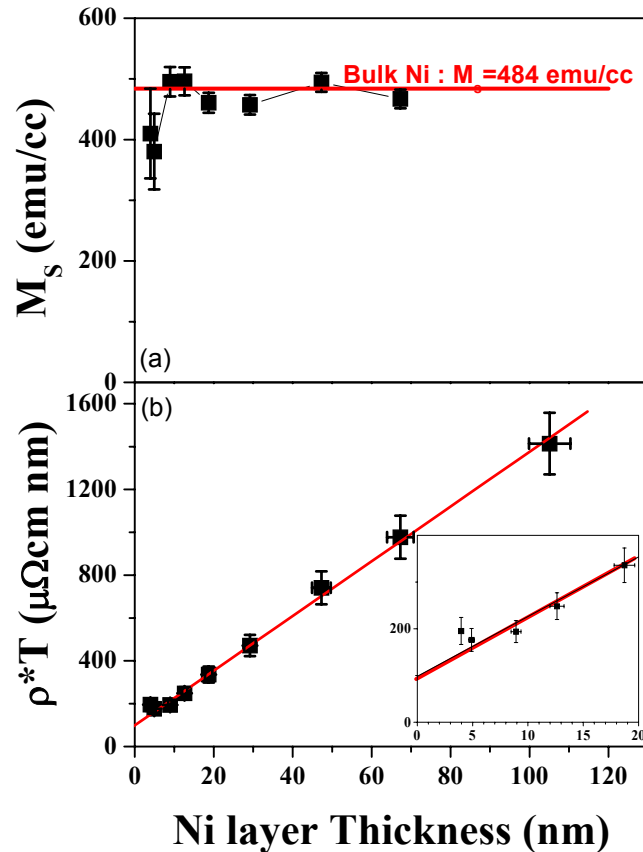


mfp @ 1444eV(As 3d)
in Ni = 1.9nm



- No Ga, As at the surface
- No or little diffusion at interface

Electrical and magnetic measurements



Bulk Ni : $M_s = 484$ emu/cc

Fuchs model:

$$\rho(T) = \rho_{\infty} + (3/8) (1-p)(\rho_{\infty} \times l_{\infty}) / T$$

with the bulk resistivity ρ_{∞} ,
 the bulk mean free path l_{∞} ,
 the “reflectivity” coefficient p

$$\rho_{\infty} = 12.8 \mu\Omega\text{cm}$$

→ No or little intermixing at the interface

Electrodeposited Ni, Co, Fe on GaAs
Future Work

- **Investigation of Ni/GaAs Schottky barrier properties**
- **Spin injection from Ni contacts into GaAs**
- **Electrodeposition on patterned p-n type GaAs,Si**