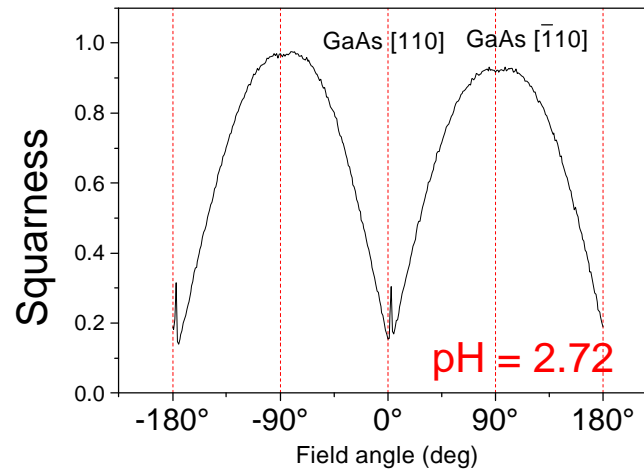


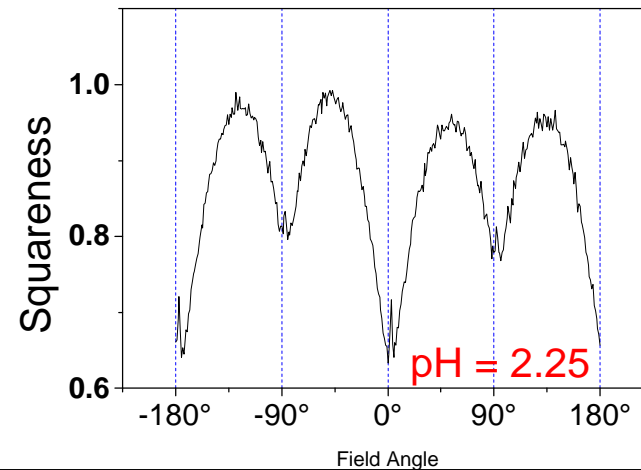
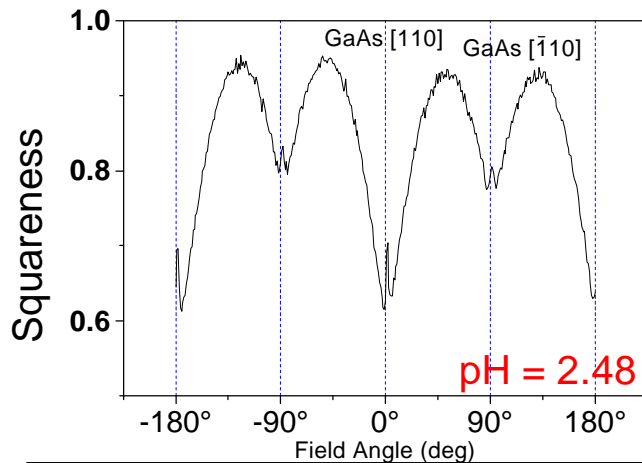
Ni films on GaAs (001) - Effect of pH

0.1M NiSO₄
4mA/cm²

**In-plane
remanence curves**

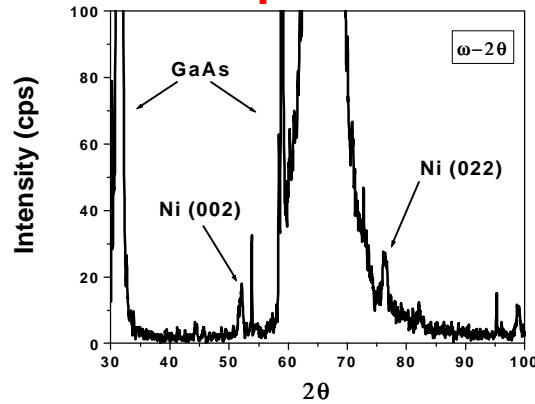


- With decreasing pH:
- **Anisotropy** changes from uniaxial to fourfold
 - The **easy axis** moves from $\langle 110 \rangle$ to $\langle 100 \rangle$



Ni on GaAs (001)

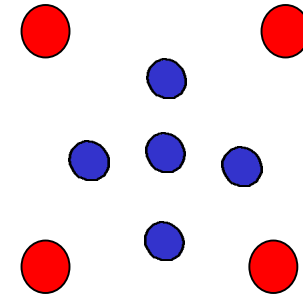
Out of plane:



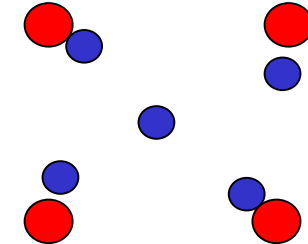
Crystalline Structure (XRD)

4 mAc_m⁻², 31 nm

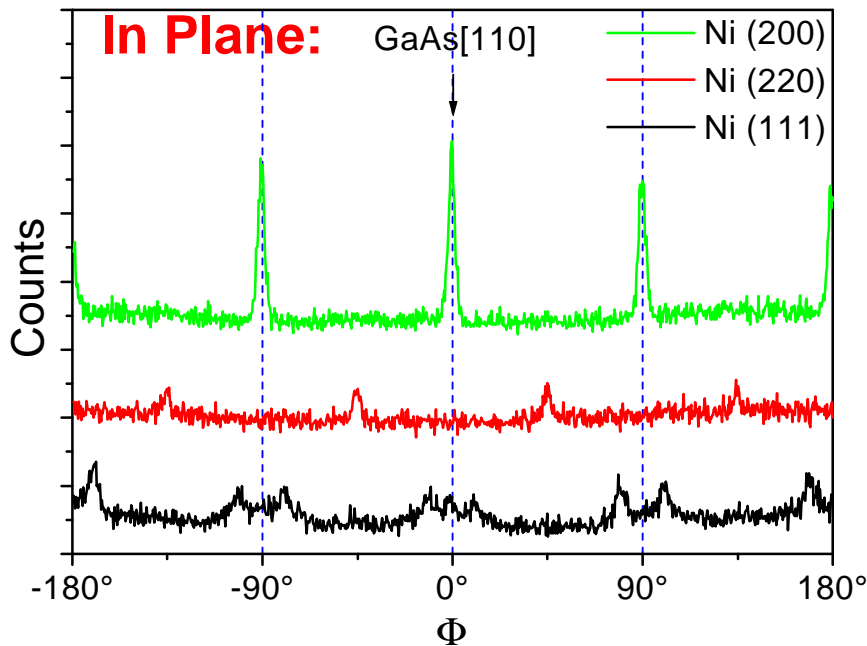
- Two epitaxial relationships seen
- Ni (200) peak increases with decreasing pH. Simulations show this is consistent with the changes seen in the remanence



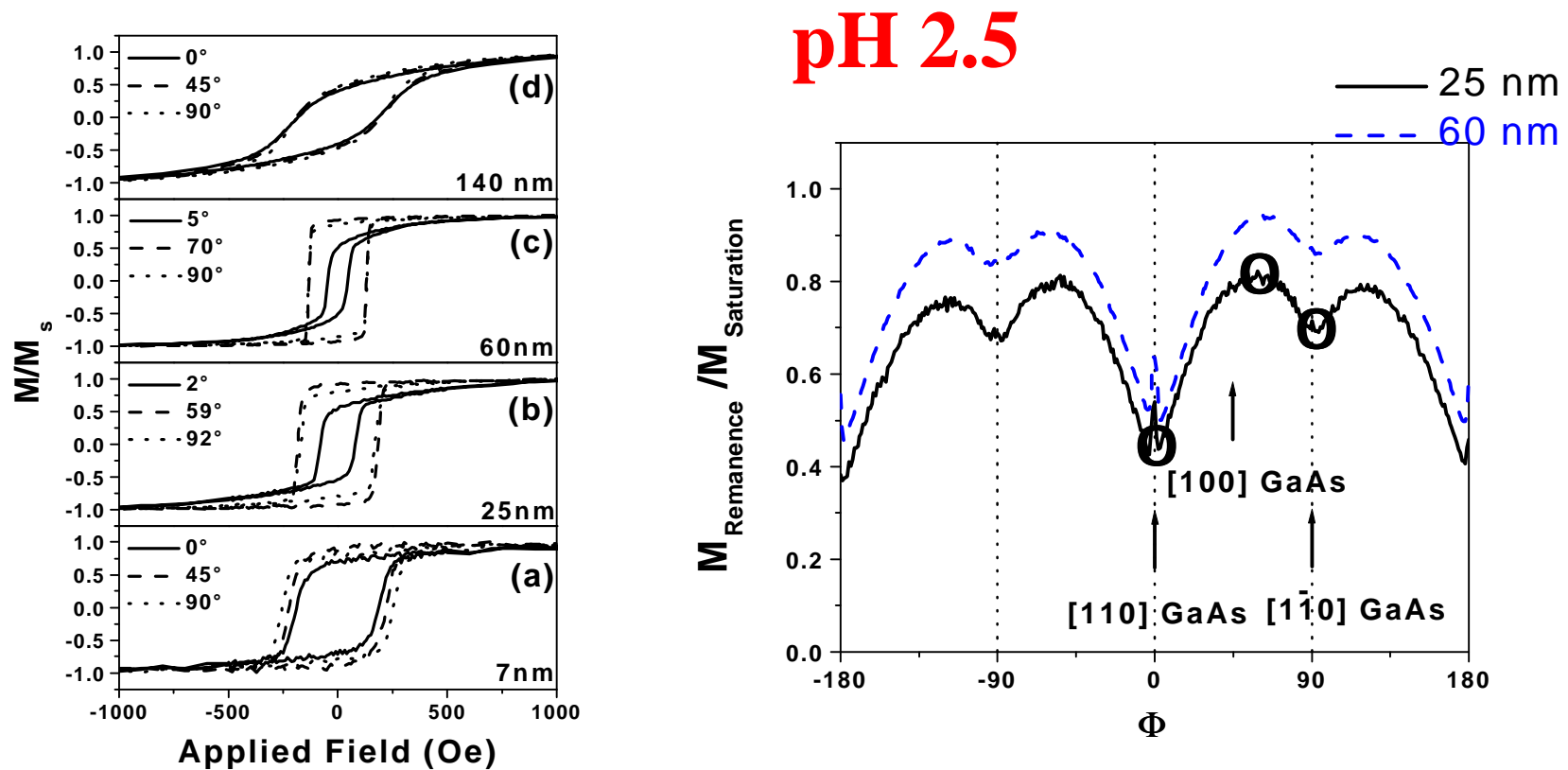
Ni (001)//GaAs (001)
Ni [110]//GaAs [100]



Ni (011)//GaAs (001)
Ni [111]//GaAs [110]
 (4 variants)



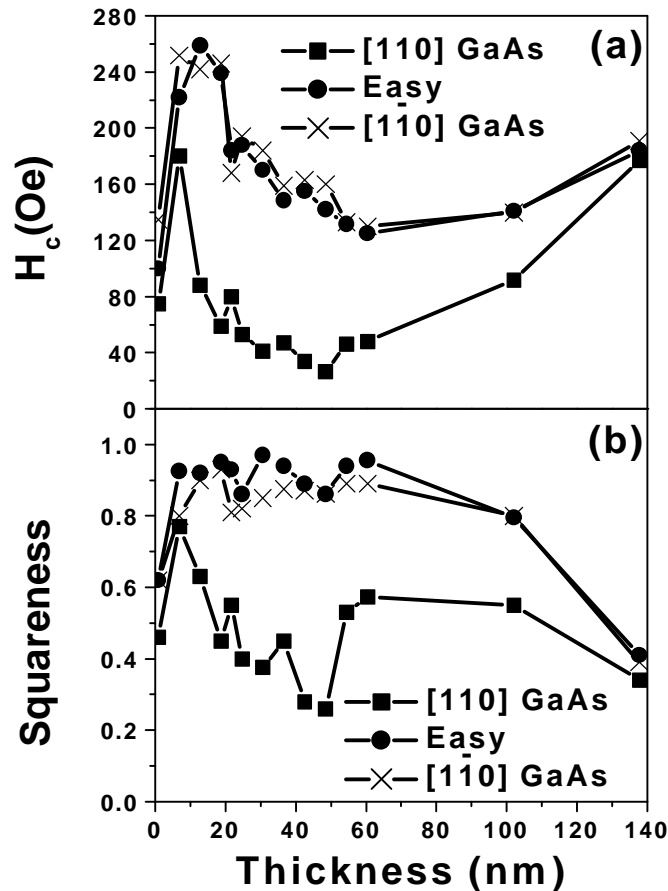
Ni/GaAs (001) : Magnetic Properties (1)



- Small four fold magnetic anisotropy
- Easy axes along GaAs $\sim [100]$

Ni/GaAs (001) : Magnetic Properties (2)

pH 2.5



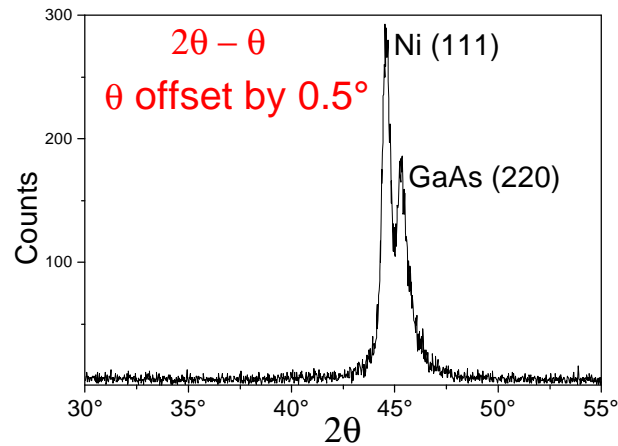
- Anisotropy decreases with increasing thickness
- Resistance measurements suggest little intermixing at the interface

Ni on GaAs (011)

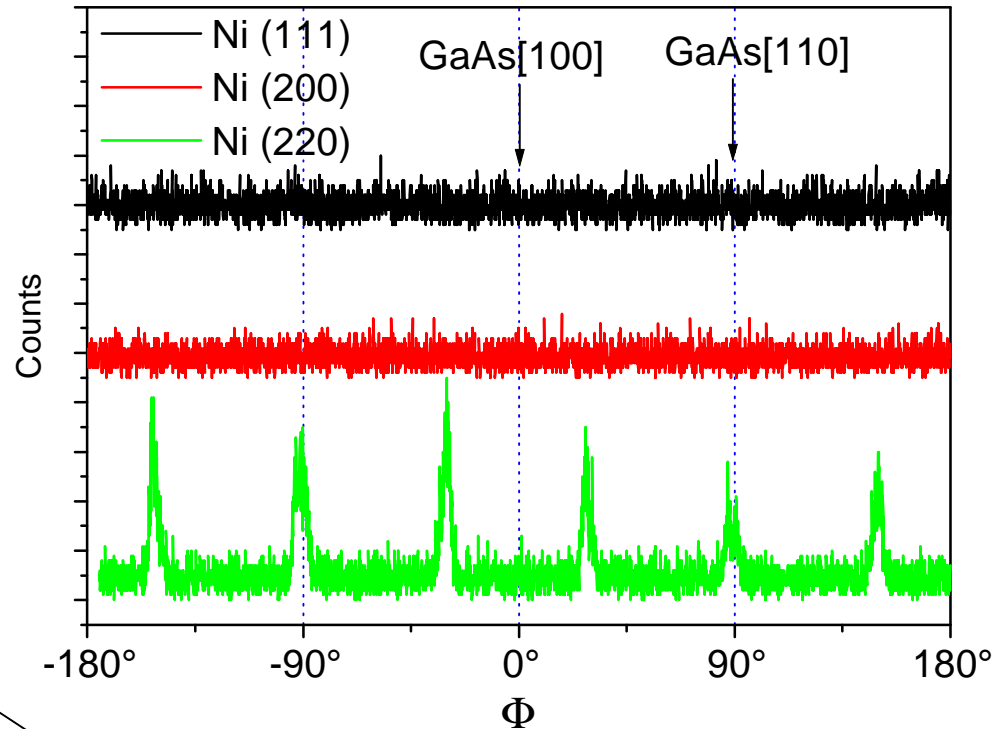
Crystalline Structure (XRD)

Out of plane:

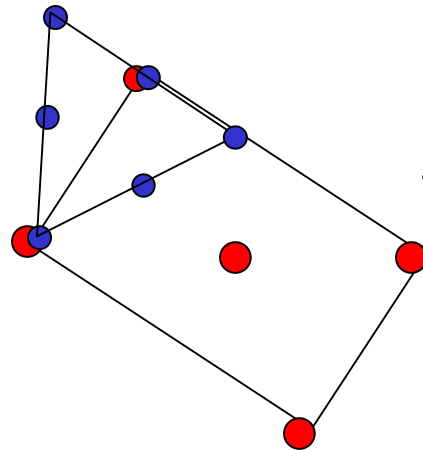
3.5mAc_m⁻², 31nm



In Plane:



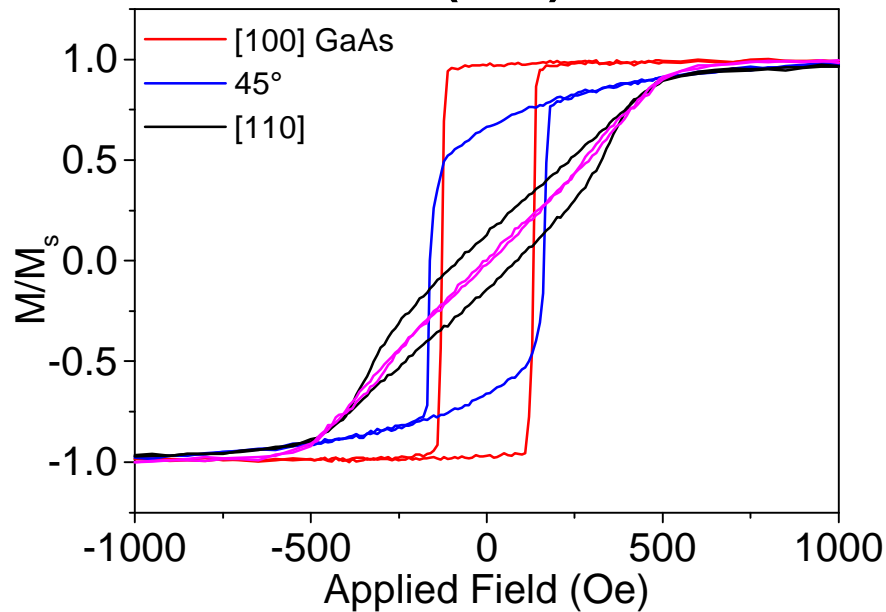
Ni films on GaAs
(011) show only a
single epitaxial
relationship



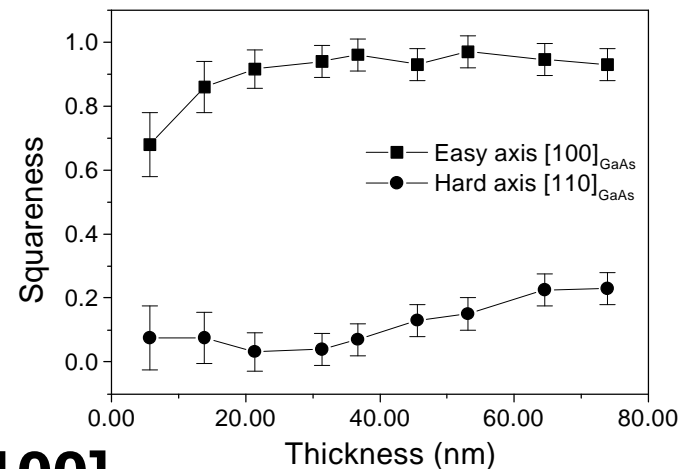
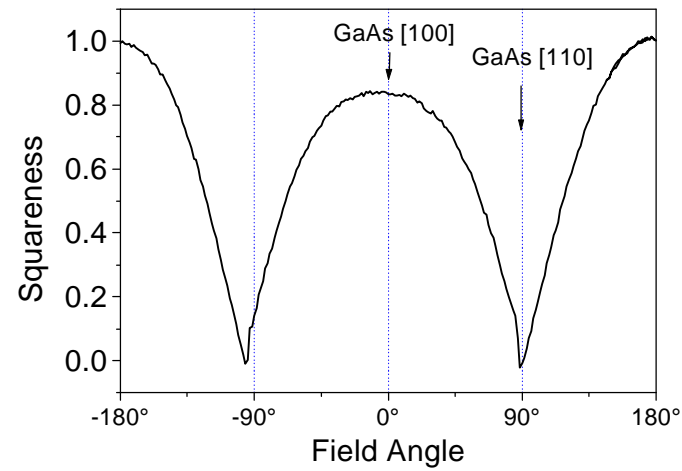
Ni(111)//GaAs(011)
Ni[110]//GaAs[110] ~

Ni/GaAs (011) : Magnetic Properties (1)

31nm Ni on (011) GaAs

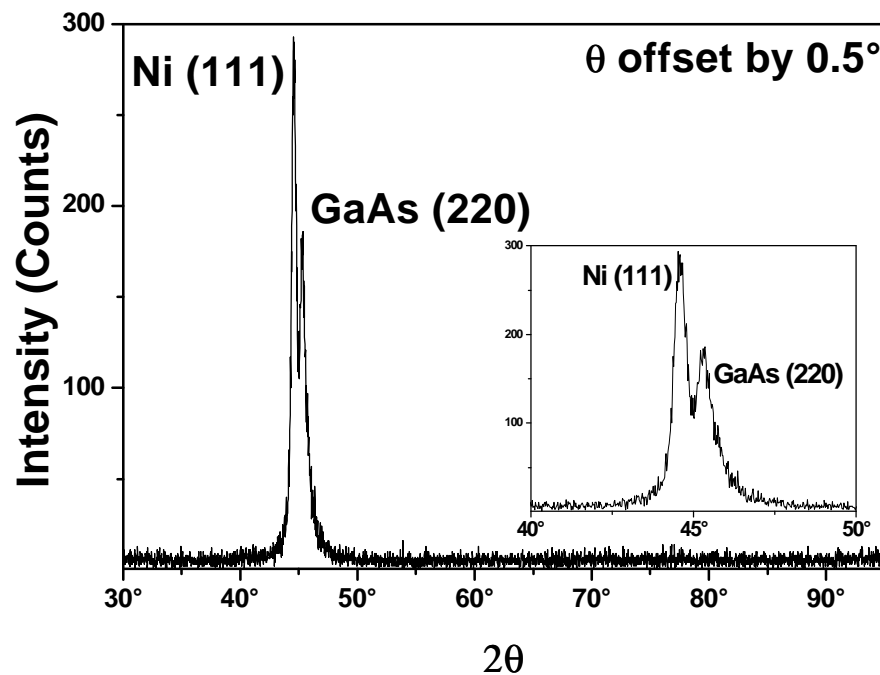


- Uniaxial anisotropy
- Independent of pH (2-3)
- Easy axis ~ along GaAs [100]

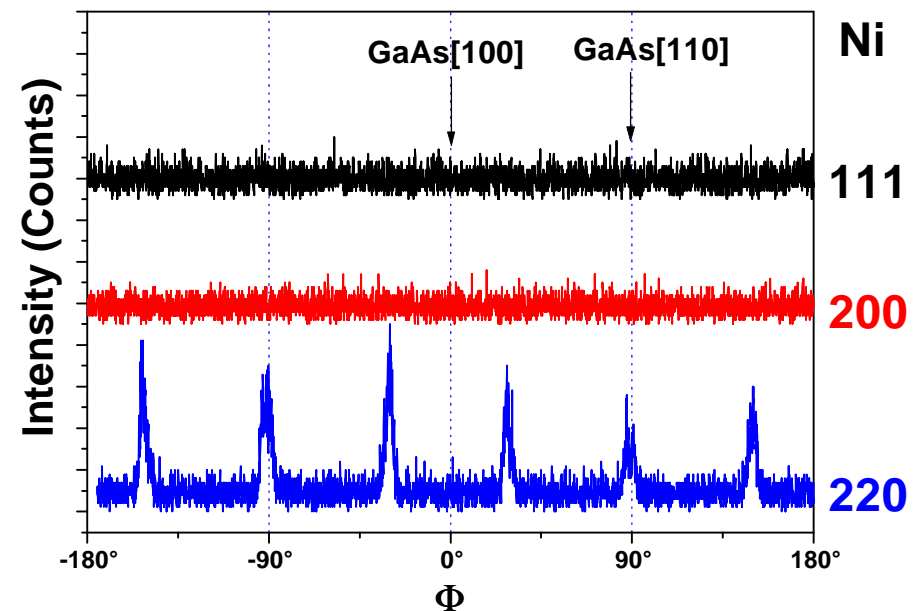


Ni-Crystalline Structure (XRD):

Out of plane



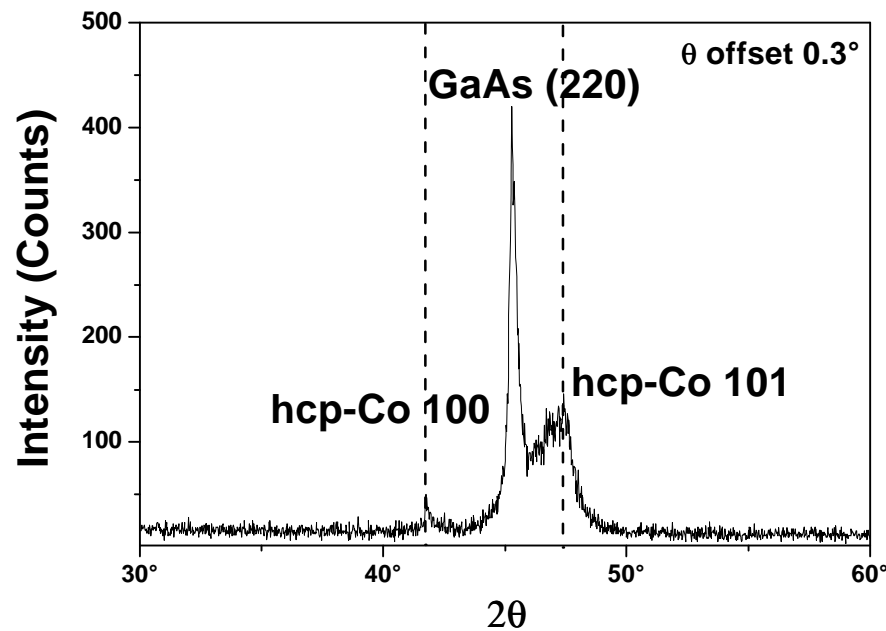
In plane



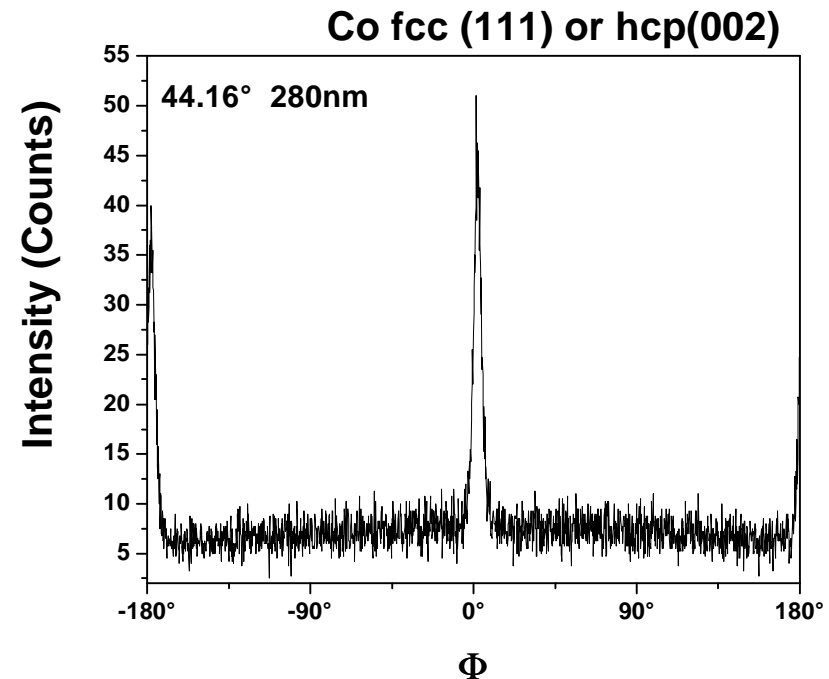
→ Epitaxial relationship **Ni(111)[110] // GaAs(011)[110]**

Co-Crystalline Structure (XRD) (1):

Out of plane



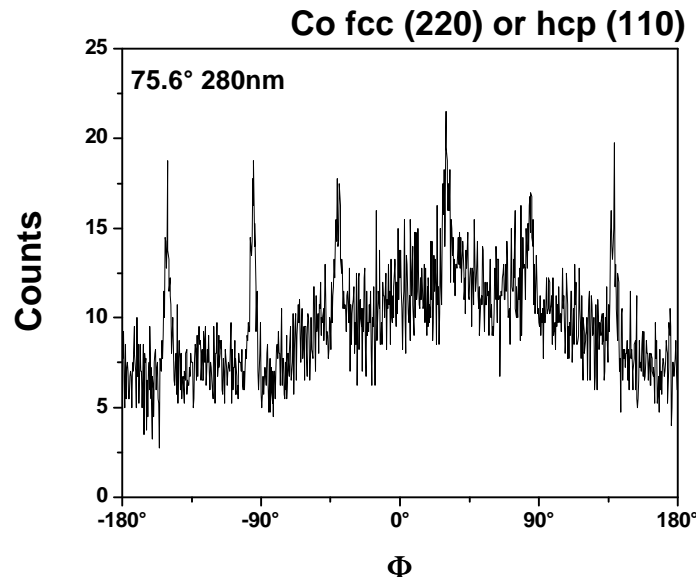
In plane



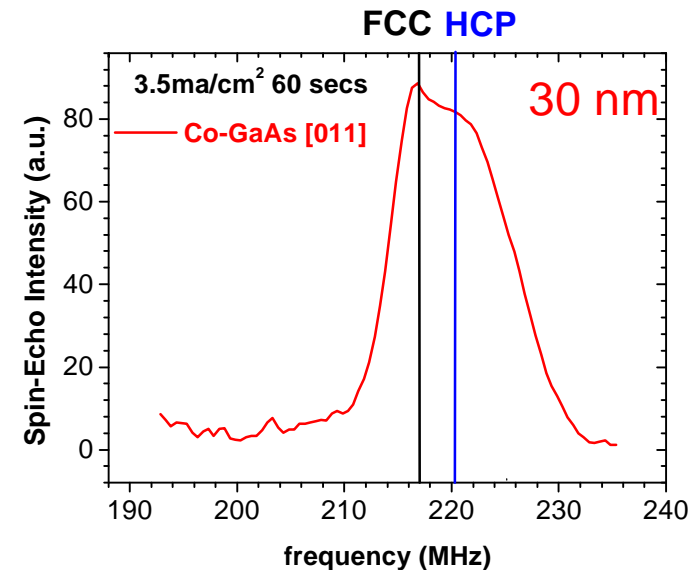
Hexagonal (hcp) or cubic (fcc) ???

Co-Crystalline Structure (XRD) (2):

In plane



NMR

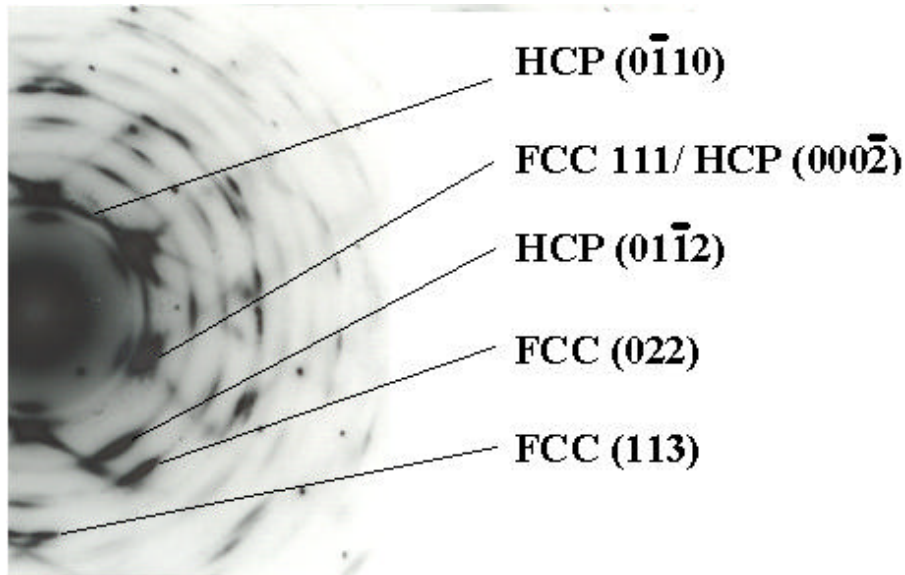


→ mixture of fcc and hcp phases confirmed by NMR

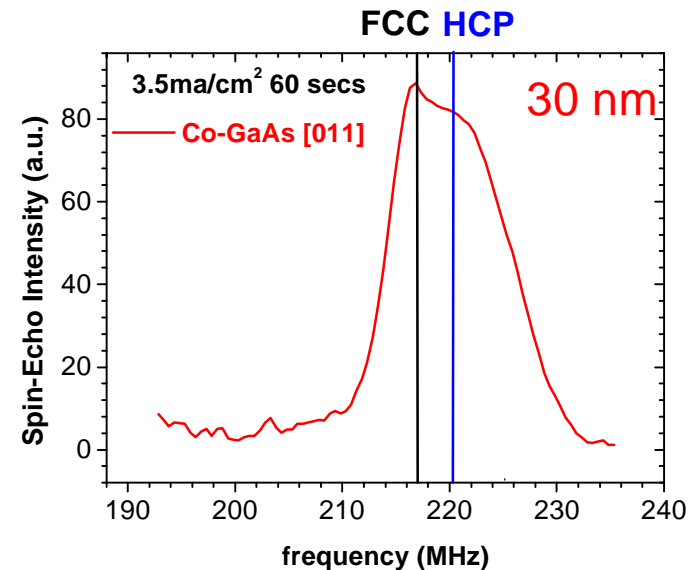
FeNi: both perpendicular and in-plane XRD scan do not show any clear peaks besides GaAs (011).

Co-Crystalline Structure (XRD) (2):

TEM



NMR

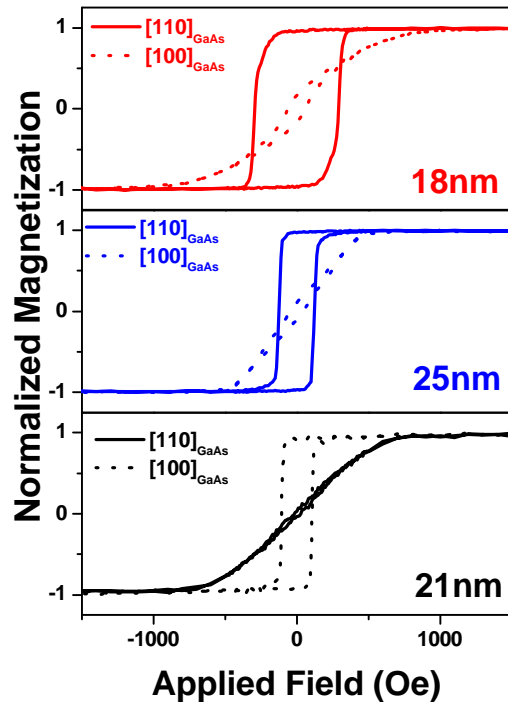


→ mixture of fcc and hcp phases confirmed by NMR

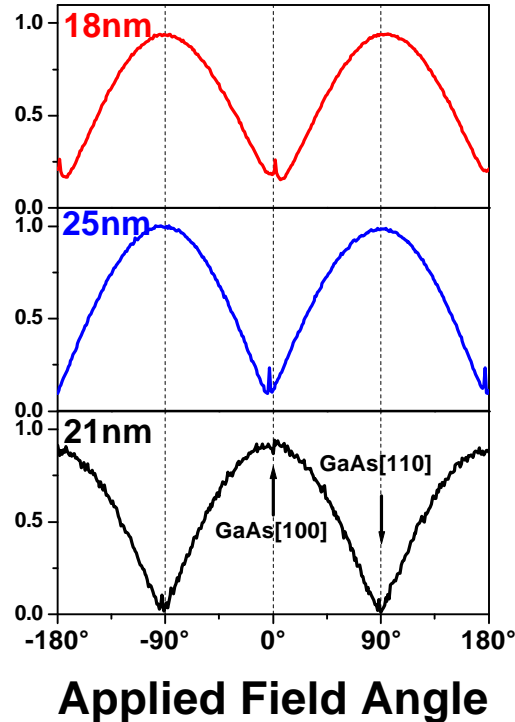
FeNi: both perpendicular and in-plane XRD scan do not show any clear peaks besides GaAs (011).

Magnetic Properties (1)

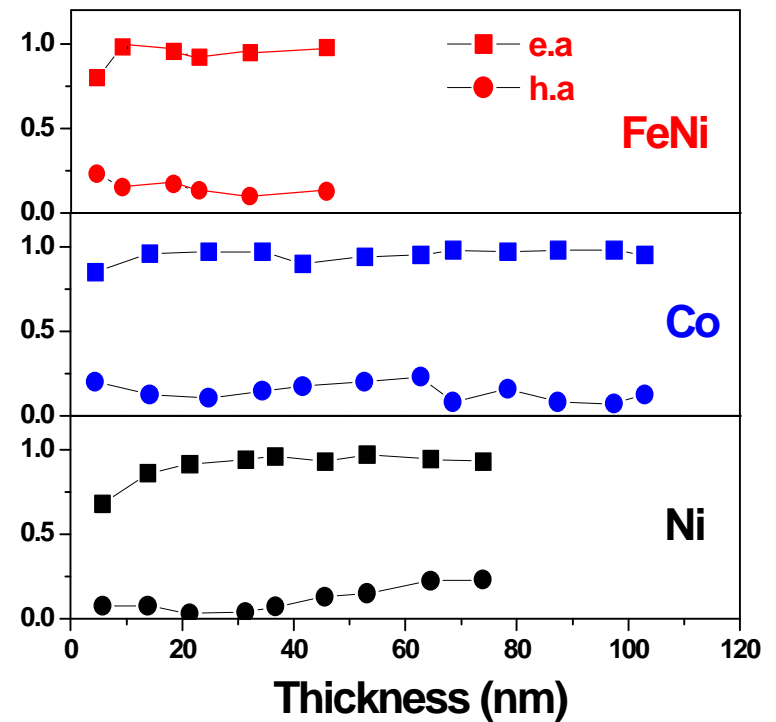
Hysteresis



Remanence

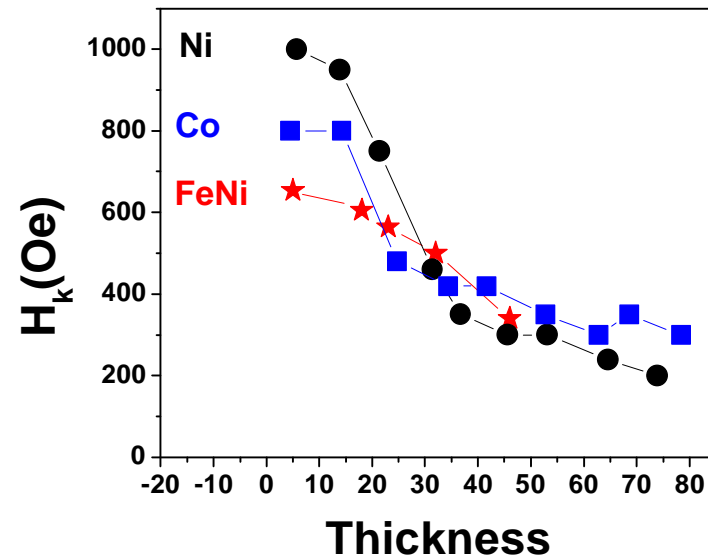
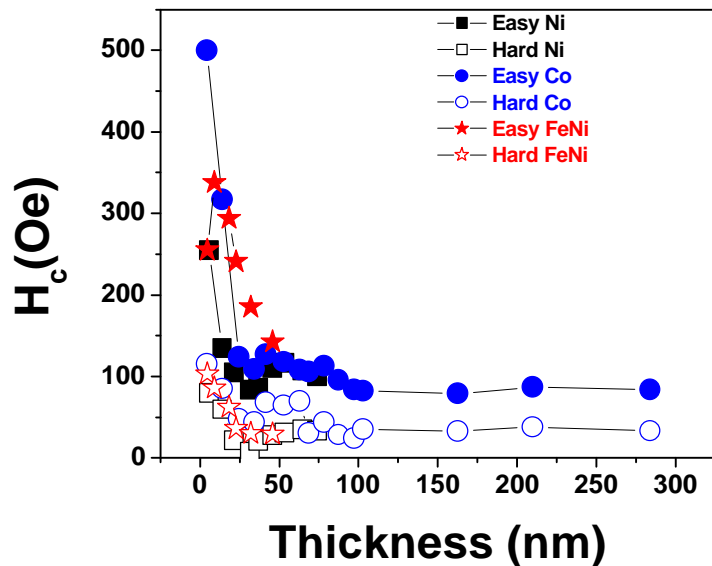


Squareness



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

Magnetic Properties (2)



- **Co films** keep its **anisotropy** even for **large thicknesses** (>250nm) and so does Ni (up to 90nm for the range studied).
- **Ni film** exhibit a **larger H_K** value (950 Oe) than anisotropy normal to crystalline anisotropy, which would be **ascribed to stress**