

MOKE characterisation of Soft Magnetic Materials

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- Soft magnetic materials
- Preparation of the samples by electrodeposition
- MOKE
- Measurements + Comment

Many applications for soft magnetic materials

- Transformers, Inductors, Electromagnets
- Sensors and actuators
- Writing magnetic recording heads
 - high M_s , low H_c , low λ
 - NiFe -> **CoNiFe**

Electrodeposition used to fabricate samples

- Potentiostat

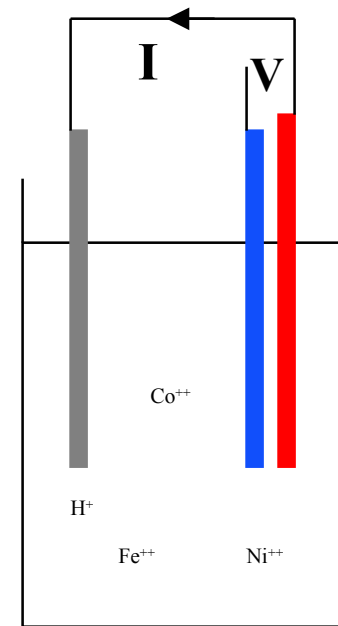
- **Cathode** : Sample
 - $M^{++} + 2e^- \rightarrow M$

Anode : Pt

Reference electrode : Ag/AgCl

Pretreatment

- Shielding electrode
- Electric contact : Ag
- Hydrophobic \leftrightarrow Hydrophilic
- H_2SO_4



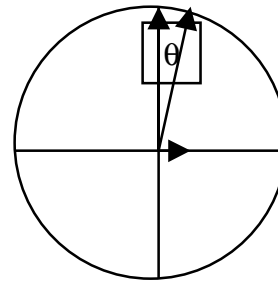
- Parameters

- Composition :
 - Concentration electrolyte
 - Voltage
- Thickness :
 - Plating time, but H^+

Principle of MOKE

- =rotation of the plane of polarization

$$\vartheta \propto M$$

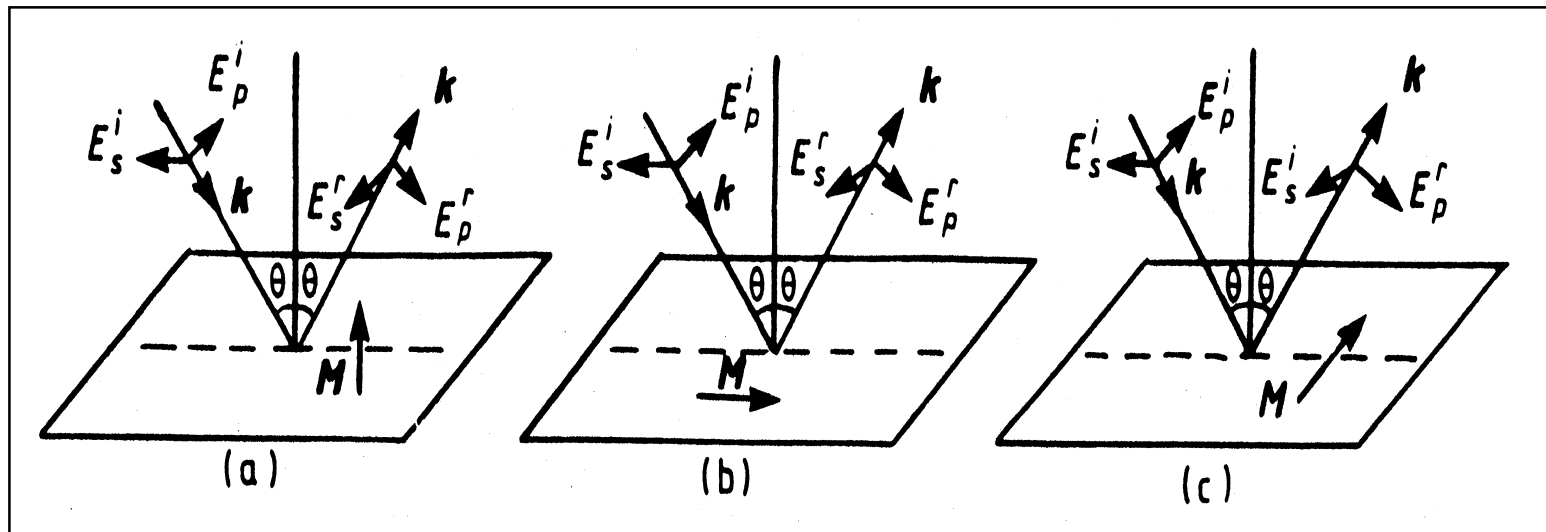


- Three configurations

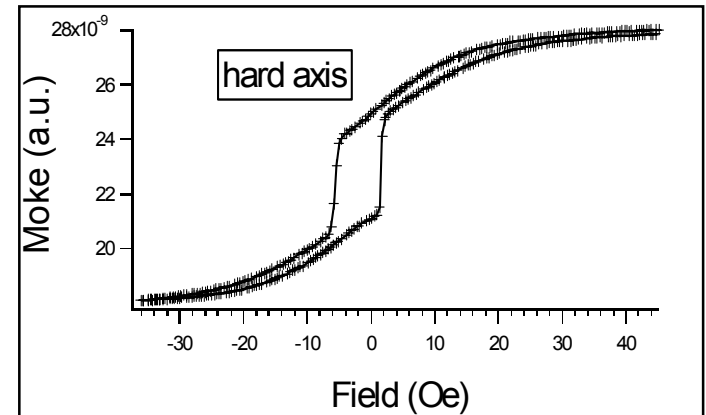
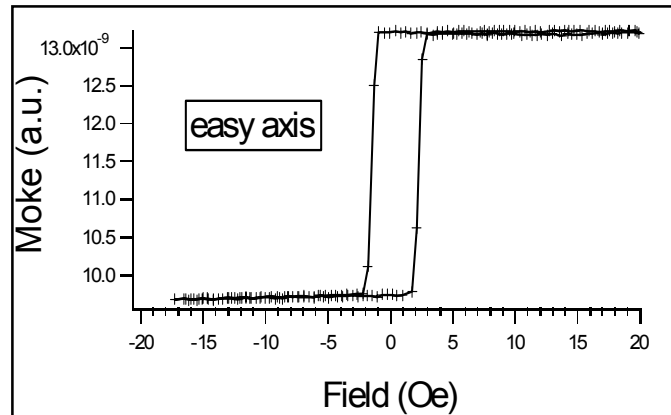
polar

longitudinal

transverse



MOKE characterisation of CoNiFe



- Uniaxial anisotropy
- Low H_c
 Optimal concentration : 10-30%Ni, 50-70%Co, 20-40%Fe
- Difficult to saturate

Soft magnetic materials push set-up to limits

- Accuracy

- Hall-sensor

- Optimizing time to stabilize

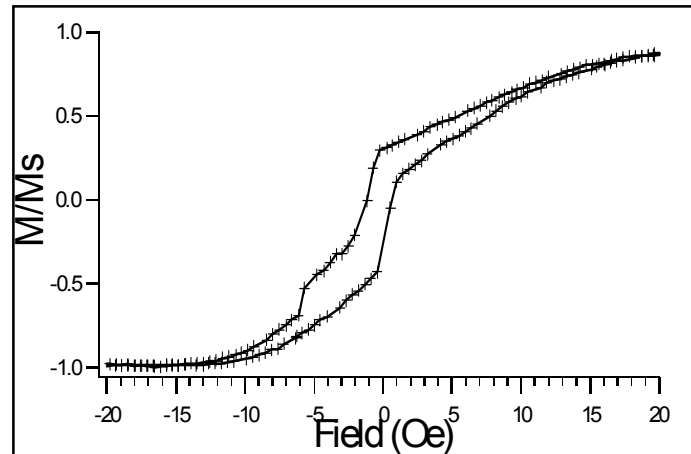
- Time to wait = $5 \times \Gamma + 50 \times \text{Step size(Oe)} + 50$ (ms)

- Flexible step size

- Need for research

- Asymmetric loops

$$\theta = k_1 \times M + k_2 \times M^2 + k_3 \times M^3 + \dots$$



- Hard axis perpendicular to concentration gradient?

Conclusion

- Electrodeposition of CoNiFe
 - fast and easy
 - inexpensive
 - excellent magnetic properties
 - Low H_c
 - High M_s
- Moke as characterisation tool for soft magnetic materials
 - + can measure soft magnetic materials(\Leftrightarrow AGFM)
 - + good magnetic field resolution
 - indirect measurement
- My contribution
 - measurements \Rightarrow relation composition- H_c
 - adaptations to the set-up \Rightarrow improvement of the accuracy