

A Switchable Neutron Spin Filter

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Motivation

The **optimal** neutron spin filter:

- high efficiency
- low absorption
- compact
- large bandwidth allow for large divergence
- switchable no need for a spin flipper
- no magnetic fields no interaction with sample(environment)
- non-deflecting simpler lay-out

Our aim:

A device fulfilling the last three requirements

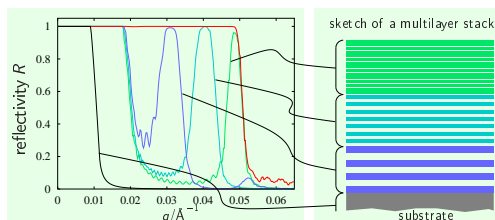
Approach: Fe/Si supermirror on Si with

- easy axis of magnetization
- high remanence
- sufficient coercive field

Preparation of the remanent polarizers by magnetron sputtering

Supermirror

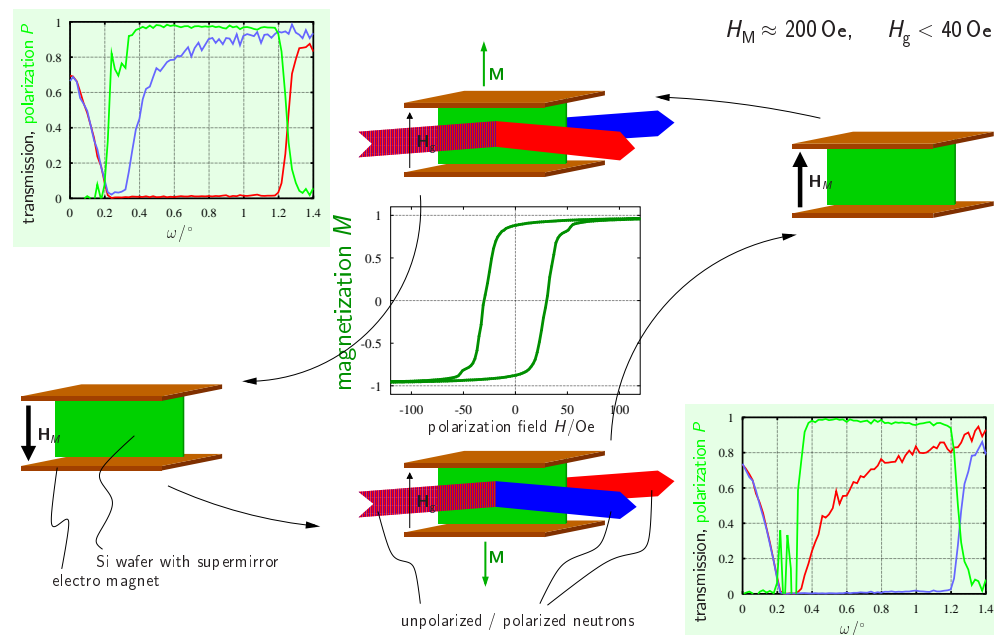
- multilayer:** causes 'Bragg peaks'
- stack of multilayers:** overlapping 'Bragg peaks'
- supermirror:** 'multilayer' with layer thickness gradient



Acknowledgments

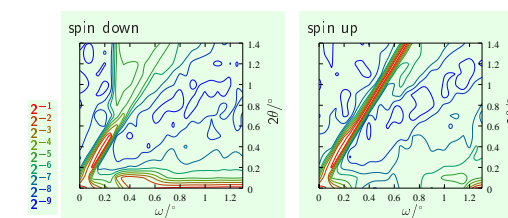
These results were obtained within the project TECHN1 of the EU program IHP/Networks with financial support from the BBW Switzerland (No. 99.0593).

Application of a remanent polarizer



Off-specular scattering

$\omega/2\theta$ mapping for polarized neutrons, $M \perp H_g$ to 'find' the lost intensity for $0.3^\circ < \omega < 0.6^\circ$



transmission: $2\theta = 0$
reflection: $2\theta = 2\omega$

Results

All shown experimental data were obtained from a **Fe/Si supermirror of 299 layers ($m = 2.5$) on Si**

The polarization

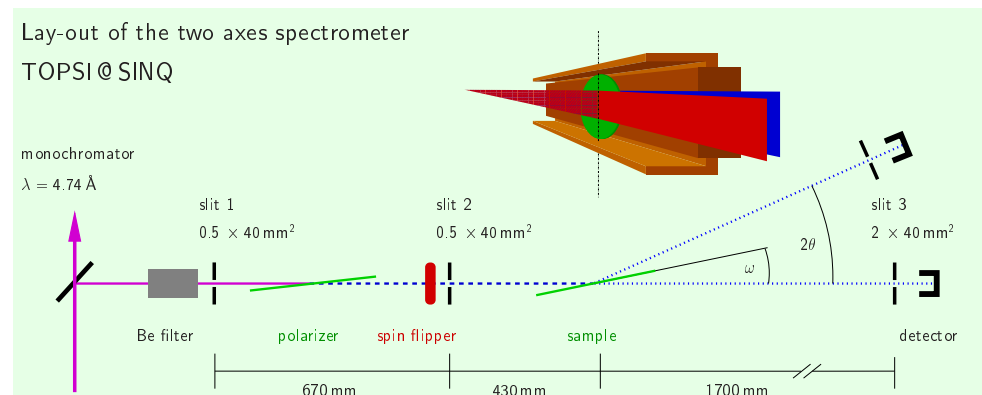
$$P = \frac{\text{majority} - \text{minority}}{\text{majority} + \text{minority}}$$

was calculated without any corrections

The polarizer can be switched by applying short magnetic field pulses.

During the measurement no field is required.

Set-up for transmission and reflectivity measurements



The **obtained** neutron spin filter:

- high efficiency $P = 96\% \rightarrow 99\%$
- low absorption $10\% \rightarrow 60\%$
- compact \times
- large bandwidth $0.18 < q/\text{nm}^{-1} < 0.55$
- switchable switching field $< 200 Oe$
- no magnetic fields coercive field $> 30 Oe$
- non-deflecting \checkmark