A Switchable Neutron Spin Filter

J. Stahn & D. Clemens

Laboratorium für Neutronenstreuung, Paul Scherrer Institut & ETH Zürich

Introduction

Aim: provide a neutron spin polarizer
- switchable
  - no need for an additional spin flipper;
- not altering the beam path
  - simpler lay-out;
- low absorption.

Approach: remanent Fe/Si supermirrors
- Fe and Si show low absorption;
- transmitted and reflected beam can be used;
- high remanence
  - operation in a weak guide field \( B_{\text{guide}} \)
  - no permanent strong field needed;
- high coercivity
  - operation with magnetization \( M \)
  - antiparallel to \( B_{\text{guide}} \);
- switching \( M \)
  - exchange of the polarization of transmitted and reflected beam.[4]

Preparation: magnetron sputtering on Si wafer
- Fe layers show anisotropic stress leading to an easy axes of magnetization.[3]
- reactive sputtering of Si with \( O_2 \) and \( N_2 \)
  - improve the matching for spin down neutrons,
  - reduce stress,
  - tune magnetic properties.

n-Measurements

The neutron intensity is measured as a function of \( \omega \) and of \( M \) for incoming spin up and spin down neutrons separately.

Results

- Sample: Fe/Si supermirror on Si, 299 layers \((m = 2.5)\);
- polarized reflectivity measurements were performed on the 2 axis neutron spectrometer TOPSI at SINQ, Switzerland,
  \( \lambda = 4.74 \text{ Å} \);
- magnetic hysteresis measured with a vibrating sample magnetometer at the PSI;
- no corrections were applied to the shown data.

\[
\begin{align*}
\text{reflectivity } R &\quad \text{polarization } P \\
\frac{P}{R} - \frac{R}{R} &\quad = 91 - 96 \% \\
\frac{P}{R} + \frac{R}{R} &\quad = 96 - 98 \%
\end{align*}
\]

A transmission polarizer using the presented supermirrors will be built for the SANS at SINQ.

References


Acknowledgments

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

Contact: Jochen Stahn, jochen.stahn@psi.ch