Giant magnetoresistance of $[Ni_{80}Fe_{20}/Au/Co/Au]_N$ multilayers deposited on flexible substrates

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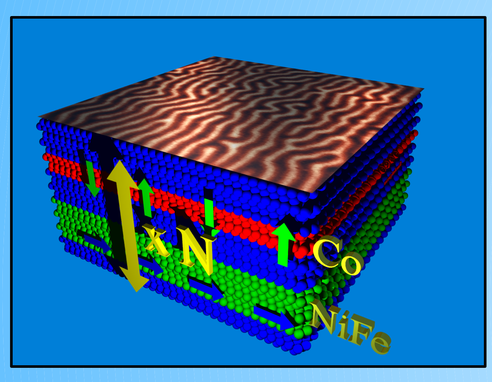
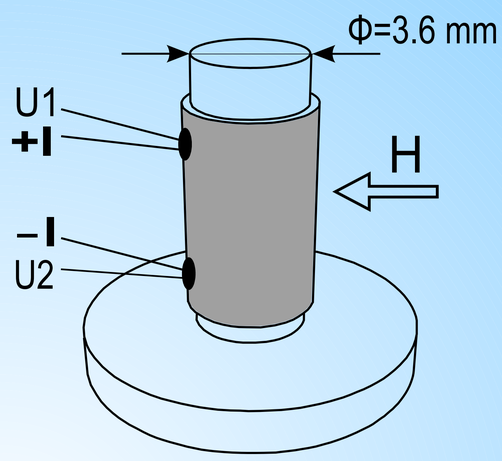
High bendability and mechanical stability of magnetic multilayers is essential to any applications in flexible electronics. In this study $[Ni_{80}Fe_{20}/Au/Co/Au]_{10}$ multilayers are deposited on polypropylene substrate to achieve possibility of bending samples retaining high magnetoresistance ratio. Magnetoresistance dependencies and magnetic hysteresis of these multilayers are compared with measurements made for multilayers on rigid Si(100) substrate.

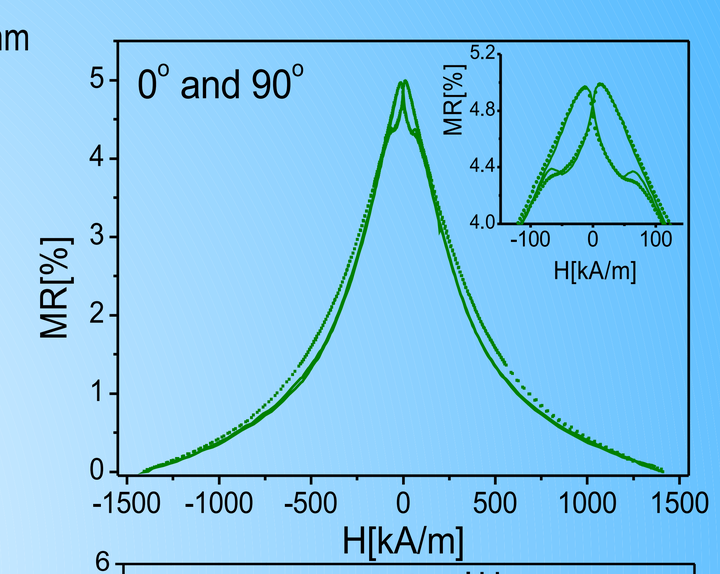
We also show that bendable sample can be utilized to form cyllindrically shaped magnetoresistive sensors with reduced anisotriopy of the effect.

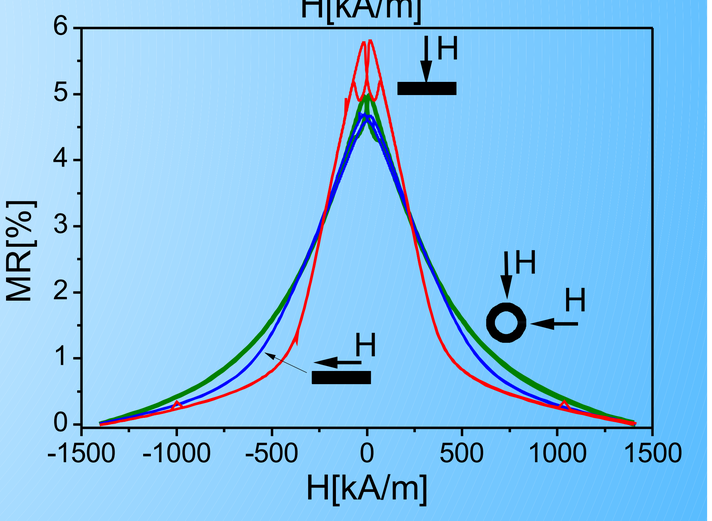


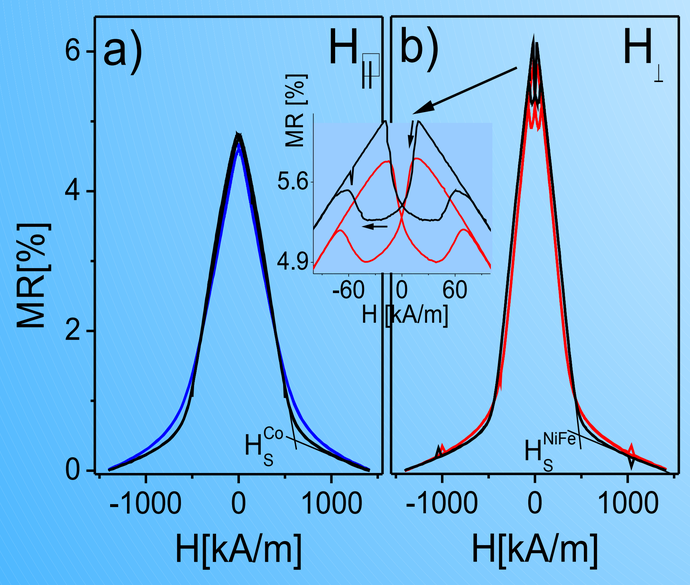
Multilayer:
sputter-deposited
spin valve-like GMR
$Ni_{80}Fe_{20}$ – in-plane anisotropy
Co – perpendicular anisotropy (stripe domains)
polypropylene tape – Scotch® Tape 508 (office-use tape)

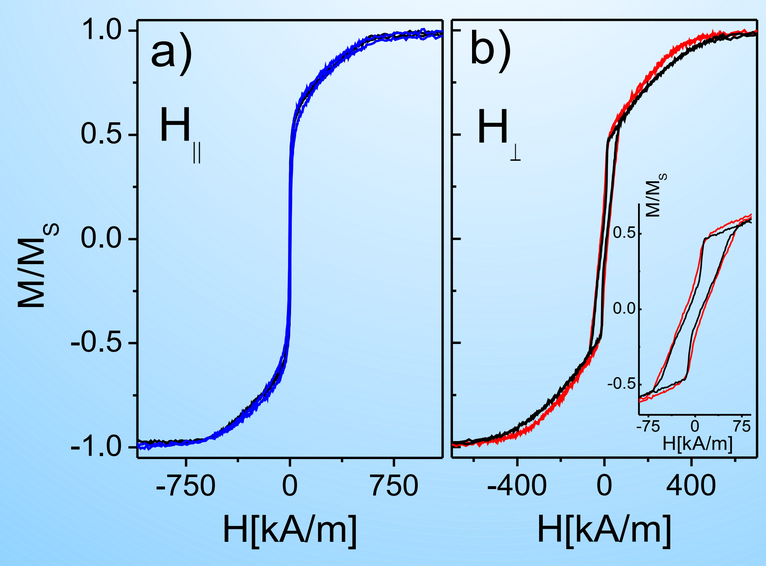
The multilayer deposited on the tape was wound around plexiglass cylinder of 3.6 mm diameter. Measurements were performed with a pseudo four-point method using electrodes made out of silver paint.











Magnetoresistance dependencies (left figure) and magnetic hystereses (right figure) of examined multilayer sputtered directly on the Si(100) substrate (black line) and on the adhesive tape (blue and red) for different field configurations.

Both samples are flat, but their roughness may be very different. Nevertheless, obtained dependencies differ <u>insignificantly</u>.

After 100 manual sample bending-unbending cycles the GMR amplitude decreased by 25%.

Magnetoresistance dependencies of multilayer wound around the cylinder (green lines) measured for field applied perpendicularily to cylinder's axis (solid line and scatter for field in two perpendicular directions) (top figure). Bottom figure compares one of green lines with results for flat tape substrate (blue and red).

Conclusions:

-Deposition of the multilayer on polypropylene substrate instead of directly on Si(100) virtually does not affect *MR(H)* and *M(H)* dependencies.
-Samples are characterized by high mechanical stability.
-The cylindrically shaped sample holder reduces the anisotropy effect of the sample and can be therefore utilized as a magnetic field sensor.
-Attained GMR amplitude (reaching 6%) is relatively high.