$Ni_{80}Fe_{20}$/Au/Co/Au multilayers as magnetic field sensors

F. Stobiecki, M. Urbaniak B. Szymański, T. Luciński, M. Schmidt, and J. Aleksiejew

Institute of Molecular Physics, Polish Academy of Sciences
M. Smoluchowskiego 17, 60-179 Poznań, Poland

Magnetic field sensors with linear R(H) (R - electrical resistance, H - magnetic field) characteristics are highly desirable [1, 2]. This requirement is fulfilled by spin valve structures consisting of two kinds of ferromagnetic layers: one with easy plane (shape anisotropy) and the other perpendicular anisotropy. Provided that magnetization reversal is carried out in field perpendicular to the surface ($H_\perp$) [3, 4]. In such a case (except for the small field range corresponding to reversal of ferromagnetic layers with easy axis parallel to the sample normal) the $R(H_\perp)$ dependence is controlled by magnetization reversal of layers with in-plane anisotropy. From the application point of view the most important properties of such sensors are large changes of resistance ($\Delta R/R$), linear $R(H_\perp)$ characteristics and lack of hysteresis. Sputter deposited $(Ni_{80}Fe_{20}/Au/Co/Au)_N$ multilayers are a good candidate for such sensors (see Fig. 1). Our samples exhibit over 5% ($\Delta R/R > 5$ % at RT) changes in resistivity, the $R(H_\perp)$ dependence is linear and reversible in magnetic fields up to 5 kOe. We will discuss the influence of the layer thickness and the repetition number N on the magnetoresistance in $Ni_{80}Fe_{20}$/Au/Co/Au multilayers.

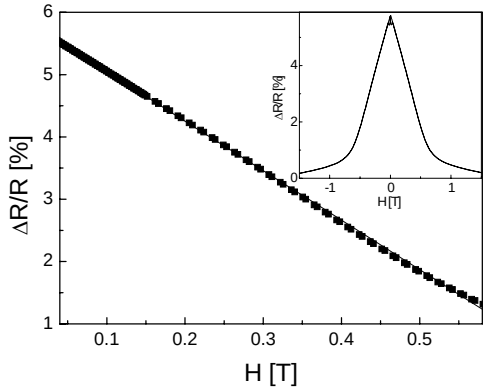

Fig. 1. Magnetoresistance effect in $(Ni\text{-}Fe/Au/Co/Au)_6$ multilayer (thickness of constituent layers are 2 nm, 2 nm, 0.6 nm for $Ni_{80}Fe_{20}$, Au, Co, respectively) demonstrated for the field range corresponding to the linear and nonhysteretic $R(H_\perp)$ dependence. Inset shows a complete curve.

[1] S. Tumański, Thin Film Magnetoresistive Sensors, Institute of Physics Publishing, Bristol and Philadelphia 2001.
[2] E.W. Hill *et al*., Sensors and Actuators A **59** (1997) 30.
[3] F.B. Mancoff *et al*., Appl. Phys. Lett. **77** (2000) 1879.
[4] F. Stobiecki *et al*., J. Magn. Magn. Mater. **272-276S** (2004) E1751.

Name of the presenting author (oral): Feliks Stobiecki
e-mail address: stfeliks@ifmpan.poznan.pl
url's: http://www.ifmpan.poznan.pl