ELECTRIC RESISTIVITY OF $Fe_{50}Co_{50}$ THIN LAYERS – – MODELLING OF EXPERIMENTAL RESULTS

T. Szumiata[1], N. Morley[2], M. Gibbs[2], S. Rigby[2], K. Warda[3]
[1]*Department of Physics, Technical University of Radom, Radom, Poland*
[2]*Department of Engineering Materials, University of Sheffield, Sheffield, UK*
[3]*Faculty of Physics and Applied Informatics, University of Łódź, Łódź, Poland*

In this work the resistivity ρ of sputtered $Fe_{50}Co_{50}$/Si thin films has been studied as a function of magnetic layer thickness. Experimental data obtained with four point method reveal a very fast increase of the resistivity for $Fe_{50}Co_{50}$ thickness $a < 20$ nm.

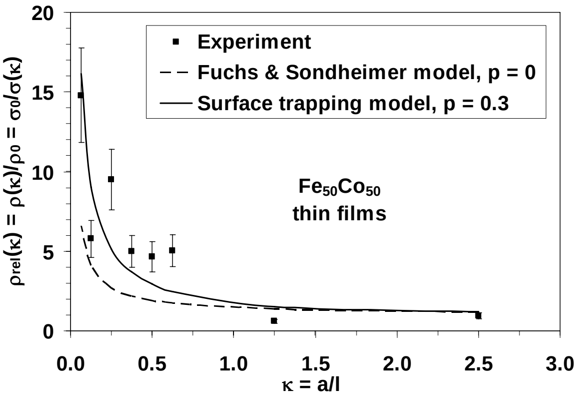

Fig. 1.

We have proved that obtained results can not be interpreted in terms of Fuchs-Sondheimer model [1,2] - even with specular reflection coefficient $p = 0$. We proposed a simple model of resistivity considering a possible trapping of electrons by surface roughness. In this case 1-*p* quantity represents a fraction of electrons "switched off " from conducting process. The ratio $\rho_{\text{rel}}(\kappa) = \rho(\kappa)/\rho_0$ of the film resistivity ρ to the resistivity of bulk material ρ_0 versus ratio $\kappa = a/l$ of film thickness *a* and mean free path *l* is described within this approach by following formulae:

$$\rho_{\text{rel}}(\kappa) = \frac{1}{\kappa}\frac{2}{1 + p\left(\frac{1}{2} + \ln\frac{1}{\kappa}\right)} \quad \text{for } \kappa \leq 1, \text{ and} \qquad \rho_{\text{rel}}(\kappa) = \frac{2}{2 - \left(1 - \frac{1}{2}p\right)\frac{1}{\kappa}} \quad \text{for } \kappa \geq 1.$$

The good accordance with experimental data (Fig. 1) has been achieved for $p \approx 0.3$ and $l \approx 40$ nm. We also suggest the enhancement of our model taking into account quantum effects, which are important when thickness of films or mean size of surface roughness is comparable with Fermi - de Broglie wave length of electrons [3,4,5]. The studied high magnetostrictive $Fe_{50}Co_{50}$ films are promising for production of sensors, actuators and MagMEMS devices [6].

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