Nanocomposites and nanomaterials

Adjusting characteristics of nanolayered magnetic sensors

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Characteristics of the nanolayered sandwich structures - the so-called spin-valves (SV) - have to be changed due to variety of application of the magnetic field sensors created on their base. In order to determine such characteristics for various parameters of the layers and external conditions, the computational method of the total energy minima calculations was developed. These calculations include the total magnetization energy of magnetostatic and in-plane uniaxial anisotropy fields. Additionally taking into consideration parameters of the SV layers and affected magnetic field one can determine the equilibrium directions of magnetizations in the ferromagnetic nanolayers. The dependencies of vector projections on the direction of applied field were depicted as magnetic hysteresis loops (Fig.1), the shape of which could be significantly modified from nearly linear to almost rectangular by variation of the applied field orientation. A computer program, created for such calculations allowed to consistently demonstrate changes of the loop shapes under variation of another parameters as anisotropy or magnetostatic interaction between magnetizations of the nanolayers (the latter can take place e.g. when interface roughness is being changed). The influence of some other factors as mechanical stress or polarized currents on the loops can be also noticeable in some cases.

As the ferromagnetic metal nanolayers in SV sandwich were mainly used Fe, Ni and as a non-magnetic separating sublayer was used conductive Cu. Such structures were studied magnetooptically by means of Kerr effect and a good coincidence of the experimentally recorded hysteresis loops with the calculated ones was obtained.