Enhanced spin-valve giant magnetoresistance by using NOL in CIP/CPP geometry

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Of late years, much study has been done in the so-called Spin Electronics, where spin transportation in CPP geometry plays an important role. But then again, MR performance of the current CIP-GMR head become reaching the ceiling even if a specula NOL technology come available. Against this background , such new science and technology as CPP-GMR with Confined-Current-Path (CCP) and Ballistic MR in magnetic nanocontact have become attracting much attention from the view point of more high sensitive MR sensor for future magnetic data storage and magnetic RAM because of their huge MR potential. On the other hand, the enhancement of CIP/CPP spin-valve giant MR by nano-oxide-layer (NOL) has been fairly well investigated in both of electron spin specula scattering for CIP and nano-constriction of spin current for CPP. In this paper, the enhanced spin-valve giant magnetoresistance by using NOL in both of CIP and CPP geometries are reviewed. It is much well known that NOL in a specula spin-valve is fairly effective to enhance MR. However, the NOL magnetism itself is not yet uncovered and understood because its ultra thin thickness. Besides, recently a new type of CPP-GMR with CCP structure has been reported, where NOL is inserted in spin-valve film stack as nano-constriction structured spacer too.

On CoFe and FeCo specula NOL, we investigated the dependence of the magnetic properties on temperature in specula spin-valve by the precise measurement of magnetization process from low to high temperature. And the spectra of conversion electron Mössbauer spectroscopy (CEMS) were also analyzed to clarify the NOL magnetism. It seems that CoFe NOL shows antiferromagnetism. And field cooling effect was observed, which supports the report from Ventura et al [1]. On CPP-GMR, two kinds of predominant approach have been presented to improve CPP-GMR performance by our group [2]. One is to increase both bulk and interfacial scattering asymmetries, beta and gamma, in metal CPP-GMR. Another is to use NOL as nano-constriction structured spacer for spin current confinement. In such constriction geometry as CPP-GMR with CCP structure, the conductance and magnetoresistance come almost entirely from the region near the constriction, thus the lead's contribution becomes smaller and can be ignored in ideal state [3]. We investigated the conductance and the magnetoresistance of spin-valve with such constriction structure as CCP NOL consisting of nonmagnetic metal bridge connected by magnetic metal layers. In this system, the magnetoresistance is strongly influenced by the metal bridge density and the purity of the metal bridge.

References

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