RB08

Characterization of Ultra-thin Fe Films Grown on MgO(100) by Magnetoresistance Measurement

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Continuous and discontinuous ultra-thin Fe films grown on MgO(100) are of particular interest since they can be incorporated into novel spin electronic nanostructures such as double-barrier magnetic tunnel junctions showing spin polarized resonant tunneling [1] and spin-dependent single electron tunneling [2]. It is well- known that magnetoresistance measurement is an effective method to characterize structural and magnetic properties of continuous and discontinuous metal/oxidemultilayers, and recently in ultra-thin Fe films prepared by triode sputtering, well-defined two-dimensional structure was suggested by the observation of enhanced and oscillatory anisotropic magnetoresistance (AMR) [3]. The objective of this study is to make magnetoresitance characterization for ultra-thin Fe films on MgO(100) substrates prepared by dc magnetron sputtering with various sputtering conditions.

Fe and MgO were deposited by dc magnetron sputtering and electron beam evaporation, respectively. The complete structure of samples is MgO sub. / MgO (10 nm) / Fe (0.8~1.9 nm) / MgO (3 nm). Epitaxial growth of each film was confirmed by reflection high energy electron diffraction (RHEED). The magnetic properties were investigated by the measurement of Kerr effect. Magnetoresistance was measured by using a conventional dc four-probe method.

Figs 1 and 2 show that the results of Kerr loop and anisotropic magnetoresistance (AMR), respectively for a 1.0 nm Fe film deposited on a MgO(100) buffer layer. It is found that the 1.0 nm Fe(100) film is morphologically continuous and is purely in the ferromagnetic state because only negligible tunnel magnetoresistance appears at the current-magnetic field angle of 45 at whichthe AMR signal is canceled out. On the other hand, a 0.8 nm Fe film showed that typical superparamagnetic behaviour suggesting that the film mophology is drastically changed and nanometric Fe particles were formed in this sample. Evolution of magnetorestance behaviour in systematically prepared Fe(100) thin films will be presented.

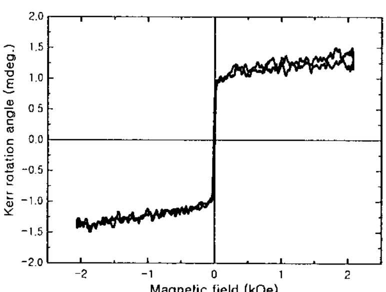

Fig. 1. Kerr effect for a 1.0 nm Fe(100) film

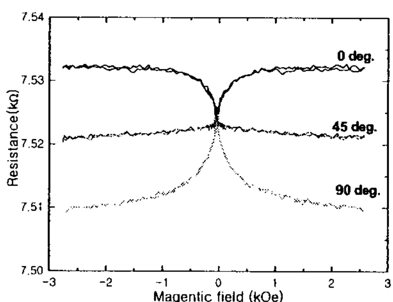

Fig. 2. Anisotropic magnetoresistance for a 1.0 nm Fe film at 77K

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RB09

The Effect on Electrical Property of Etched Magnetic Tunnel Junction Stack in Cl_2/Ar and HBr/Ar plasma

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Recently, magnetic random access memory (MRAM), based on magnetic tunnel junction (MTJ) and CMOS, is one of the prominent candidates among new memories which provide nonvolatility, fast access time, unlimited read/write endurance, low operating voltage, and high storage density. The etching of MTJ stack is one of the important processes for the realization of high density MRAM devices [1].

The electrical properties of MTJ stack were investigated using an inductively coupled plasma reactive ion etching in Cl_2/Ar and HBr/Ar gas mixtures. Since the MTJ stack, which consists of various magnetic materials, metals, and a tunneling barrier layer, rarely reacted with chemical species in a plasma [2], TiN hard mask were employed for high etch selectivity in the etching of MTJ stack.

The effect on electrical properties of MTJ stack was examined by varying Cl_2 concentration. As Cl_2concentration increased, resistance of MTJ stack increased but magnetoresistance (MR) ratio was similar. The decrease of resistance of MTJ stack was due to formation of MgOH by the reaction of MgO with hydrogen

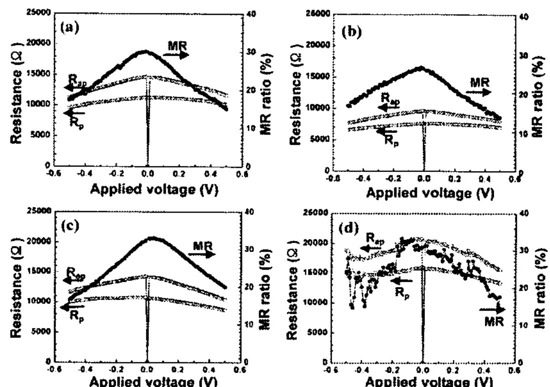

Fig.1. R-V curve of etched MTJ stack at (a) pure Ar, (b) 20% Cl2, (c) 40% Cl2, and (d) 60% Cl2.

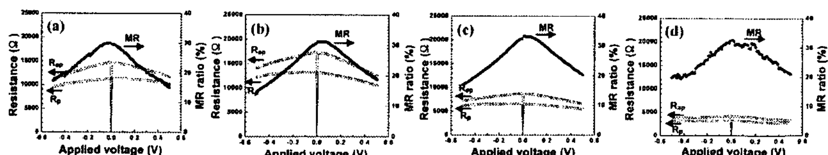

Fig. 2. R-V curve of etched MTJ stack at (a) pure Ar, (b) 20% HBr, (c) 40% HBr, and (d) 60% HBr.

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