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The effect of annealing on the MR and exchange bias characteristics in dual spin valve

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For over 10 % MR amplitude and very high sensitivity in the spin valve devices such as read head for magnetic recording and magnetic sensor, dual spin valve structure can be one of candidates. The dual spin valve has both the top pinned layer and the bottom pinned layer structure. Above all, the MR properties of the dual spin valve depend on the exchange coupling by antiferromagnetic(AF) layers of two pinned layers, and heat treatment influences largely upon the exchange coupling at the interface of ferromagnetic(FM) layer/AF layer. Thus, we have investigated the MR properties and the variation of both the bottom and the top pinning effects in dual spin valve films by heat treatment. We prepared the spin valve structure of Ta/NiFe/FeMn/CoFe/Cu/CoFe/NiFe/CoFe/Cu/CoFe/FeMn/Ta on the Si(100)/SiO_2(1500 Å) by d.c. magnetron sputtering system. MR amplitude of as-deposited spin valve films was 9.1~9.9 %. We obtained from the representative MR curve the result that the exchange bias of the top pinned layer is 220 Oe and that of the bottom pinned layer is less than 100 Oe. Large asymmetry of exchange bias like this was overcome by the magnetic annealing at near blocking temperature of AF layer and MR amplitude also was improved over 10 %. Annealed dual spin valve has the exchange coupling of 200 Oe(0.9 erg/cm^2) and 320 Oe(1.4 erg/cm^2). In this presentation, we will show the MR, exchange bias and microstructure characteristics of the dual spin valve according to different annealing temperature. Furthermore, we will present MR behavior in dual spin valve with specular effect