

High density plasma etching of CoFeB and IrMn magnetic films with Ti hard mask

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Magnetic random access memory (MRAM), based on magnetic tunnel junction (MTJ) and CMOS, is a prominent candidate among prospective semiconductor memories because it can provide nonvolatility, fast access time, unlimited read/write endurance, low operating voltage and high storage density. The etching of MTJ stack with good properties is one of a key process for the realization of high density MRAM. In order to achieve high quality MTJ stack, the use of CoFeB and IrMn magnetic films as free layers was proposed.

In this study, inductively coupled plasma reactive ion etching of CoFeB and IrMn thin films masked with Ti hard mask was investigated in a Cl_2/Ar gas mix. The etch rate of CoFeB and IrMn films were examined on varying Cl_2 gas concentration. As the Cl_2 gas increased, the etch rate monotonously decreased. The effective of etch parameters including coil rf power, dc-bias voltage, and gas pressure on the etch profile of CoFeB and IrMn thin film was explored, At high coil rf power, high dc-bias voltage, low gas pressure, the etching of CoFeB and IrMn displayed better etch profiles. Finally, the clean and vertical etch sidewall of CoFeB and IrMn free layers can be achieved by means of thin Ti hard mask in a Cl_2/Ar plasma at the optimized condition.