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Inductively Coupled Plasma Reactive Ion Etching of MgO Thin Films Using a CH_4/Ar Plasma

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These days, a growing demand for memory device is filled up with the flash memory and the dynamic random access memory (DRAM). Although DRAM is a reasonable solution for current demand, the universal novel memory with high density, high speed and nonvolatility, needs to be developed. Among various new memories, the magnetic random access memory (MRAM) device is considered as one of good candidate memories because of excellent features including high density, high speed, low operating power and nonvolatility.

The etching of MTJ stack which is composed of magnetic materials and insulator such as MgO is one of the vital process for MRAM. Recently, MgO has attracted great interest in the MTJ stack as tunneling barrier layer for its high tunneling magnetoresistance values. For the successful realization of high density MRAM, the etching process of MgO thin films should be investigated.

Until now, there were some works devoted to the investigations on etch characteristics of MgO thin films. Initially, ion milling was applied to the etching of MgO thin films. However, ion milling has many disadvantages such as sidewall redeposition and etching damage. High density plasma etching containing the magnetically enhanced reactive ion etching and high density reactive ion etching have been employed for the improvement of etching process.

In this work, inductively coupled plasma reactive ion etching (ICPRIE) system was adopted for the improvement of etching process using MgO thin films and etching gas mixes of CH_4/Ar and CH_4/O_2/Ar have been employed. The etch rates are measured by a surface profilometer and etch profiles are observed using field emission scanning emission microscopy (FESEM). The effects of gas concentration and etch parameters such as coil rf power, dc-bias voltage to substrate, and gas pressure on etch characteristics will be systematically explored.

Keywords: Inductively Coupled Plasma Reactive Ion Etching, MgO Thin Film, Magnetic Tunnel Junction, CH_4/Ar gas