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Effects of Etch Parameters on Etching of CoFeB Thin Films in $CH_4/O_2/Ar$ Mix

Tea Young Lee, Il Hoon Lee, Chee Won Chung

Department of Chemical Engineering, Inha University

Information technology industries has grown rapidly and demanded alternative memories for the next generation. The most popular random access memory, dynamic random-access memory (DRAM), has many advantages as a memory, but it could not meet the demands from the current of developed industries. One of highlighted alternative memories is magnetic random-access memory (MRAM). It has many advantages like low power consumption, huge storage, high operating speed, and non-volatile properties. MRAM consists of magnetic-tunnel-junction (MTJ) stack which is a key part of it and has various magnetic thin films like CoFeB, FePt, IrMn, and so on. Each magnetic thin film is difficult to be etched without any damages and react with chemical species in plasma. For improving the etching process, a high density plasma etching process was employed. Moreover, the previous etching gases were highly corrosive and dangerous. Therefore, the safety etching gases are needed to be developed. In this research, the etch characteristics of CoFeB magnetic thin films were studied by using an inductively coupled plasma reactive ion etching in $CH_4/O_2/Ar$ gas mixes. TiN thin films were used as a hardmask on CoFeB thin films. The concentrations of O_2 in $CH_4/O_2/Ar$ gas mix were varied, and then, the rf coil power, gas pressure, and dc-bias voltage. The etch rates and the selectivity were obtained by a surface profiler and the etch profiles were observed by a field emission scanning electron microscopy. X-ray photoelectron spectroscopy was employed to reveal the etch mechanism.

Keywords: CoFeB magnetic thin films, Magnetic tunnel junction, Inductively coupled plasma reactive ion etching, $CH_4/O_2/Ar$ gas