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Investigation on Etch Characteristics of FePt Magnetic Thin Films Using a CH_4/Ar Plasma

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Magnetic random access memory (MRAM) is one of the prospective semiconductor memories for next generation. It has the excellent features including nonvolatility, fast access time, unlimited read/write endurance, low operating voltage, and high storage density. MRAM consists of magnetic tunnel junction (MTJ) stack and complementary metal-oxide semiconductor (CMOS). The MTJ stack is composed of various magnetic materials, metals, and a tunneling barrier layer. For the successful realization of high density MRAM, the etching process of magnetic materials should be developed.

Among various magnetic materials, FePt has been used for pinned layer of MTJ stack. The previous etch study of FePt magnetic thin films was carried out using $CH_4/O_2/NH_3$. It reported only the etch characteristics with respect to the variation of RF bias powers.

In this study, the etch characteristics of FePt thin films have been investigated using an inductively coupled plasma reactive ion etcher in various etch chemistries containing CH_4/Ar and CH_4/O_2/Ar gas mixes. TiN thin film was employed as a hard mask. FePt thin films are etched by varying the gas concentration. The etch characteristics have been investigated in terms of etch rate, etch selectivity and etch profile. Furthermore, x-ray photoelectron spectroscopy is applied to elucidate the etch mechanism of FePt thin films in CH_4/Ar and CH_4/O_2/Ar chemistries.

Keywords: FePt thin films, Magnetic tunnel junction, Inductively coupled plasma reactive ion etching, CH_4/Ar gas