High density plasma reactive ion etching of Co_2MnSi thin films using a CH_3OH/Ar gas mixture for magnetic random access memory applications

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Co_2MnSi thin films have recently been used in spin transfer torque magnetic random access memory (STT-MRAM) devices as MTJ stacks magnetic layers, owing to their large energy gap (0.4 eV) in the minority band and its high Curie temperature (985 K) relative to other Heusler compounds. For the proper patterning of Co_2MnSi thin films selection of a proper etching gas and optimization of the etch parameters using inductively coupled plasma reactive ion etching (ICPRIE) is necessary.
In this study, ICPRIE of Co_2MnSi thin films using CH_3OH/Ar gas mixture have been performed by varying CH_3OH concentration in CH_3OH/Ar gas mixture. The etch rate, etch selectivity to hard mask, the etch profile and etch mechanism were investigated by analyzing the etched films using surface profilometer, Scanning Electron Microscopy (SEM), and Optical Emission Spectroscopy (OES) analyses. Optical emission spectroscopy analysis revealed that [H], [O], [CO], [OH], [CH_3O] and [Ar] species in the CH_3OH/Ar plasma played a key role in achieving a good etch profile.