Effect of Non-Corrosive Gas Mixture on Etching of Cu thin film Using Inductively Coupled Plasma Reactive Ion Etching

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Copper is widely used as an electrode material in various devices, but in the semiconductor device, only a few devices are used, and aluminum is used more widely due to the easy etching. However, as the minimum feature dimensions of the device shrinks, it increases the current density flowing through the aluminum wiring and the resistivity of aluminum compared to the copper resistivity. Copper is advantageous in terms of information processing speed of semiconductor devices because it has a lower resistivity than aluminum, and has a high resistance to electron movement. Until recently, reactive ion etching of copper thin films using various gases including Cl_2,$SiCl_4$, HBr, HCl, CCl_4 gas were carried out and the results were not satisfactory because of non-reactivity and non-volatility of copper films. In the all cases, the etch-by products were produced and deposited on the copper films without leaving off the copper films.

In this study, the influences under non-corrosive gas mixture containing CH_3OH/Ar, C_2H_5OH/Ar, CH_4/Ar, and CH_4/O_2/Ar chemistries have been investigated using inductively coupled plasma reactive ion etching. The influences of the gas concentration, ICP rf power, dc-bias voltage and process pressure on each characteristic were investigated. Etch profile of copper film was investigated by field emission scanning electron microscopy. In addition, X-ray photoelectron spectroscopy and energy dispersive X-ray spectroscopy were used to investigate the etched film surfaces for the understanding of the etch mechanism in the chemistry.

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