Optimizing Ru Dry Etch for High – κ Metal Electrode MOS Devices

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ITRS states that future generation CMOS will require high-k in conjunction with metal gate electrodes to remove polysilicon depletion effects. The selection of the metal gate material will be driven by the workfunction of the metal in order to control the threshold voltage of the transistors. Candidate metals should have a workfunction within 0.2v of the conduction band and the valance band edges for NMOS and PMOS respectively. The potential NMOS candidate metals are more reactive while the PMOS candidates are more noble like and this creates an etch challenge for dual metal CMOS integration.

This paper addresses the optimization of Ruthenium dry etch which is a noble like PMOS candidate. Oxygen/Chlorine plasmas in a capacitive coupled etch tool were studied based on the volatility of RuO_4 and low physical etch component contributed from the tool design. A fractional factorial screening experiment was performed to determine and thereby optimize the etch characteristics. Trends of plasma parameters such as chlorine concentration, Rf power, process pressure with respect to etch rate and etch effluence were studied and will be discussed. The optimized etch conditions were used to etch Ruthenium gate electrodes on high – κ dielectrics building MOS capacitors.