POST OXIDE ETCHING CLEANING PROCESS USING INTEGRATED ASHING AND HF VAPOR PROCESS

Ohseung Kwon and Herbert H. Sawin
MIT
77 Massachusetts Ave. #66-217
Cambridge, MA 02139

A totally integrated dry cleaning process after oxide etching in fluorocarbon gases was proposed and demonstrated on blanket oxide film and patterned 4" wafers. Oxide etching was performed using Inductively Coupled Plasma (ICP) etcher using 100 % CHF_3 gas. In-situ oxygen plasma and HF vapor were used for cleaning fluorocarbon polymeric contamination formed during oxide etching. This process sequence was performed in a vacuum cluster system in our laboratory. In this apparatus, we have the ability to transfer samples between processing chambers and perform surface analysis at a base pressure in the 10^{-9} torr range. In this manner, we can mimic a clustered process, avoid ambient contamination, and obtain an accurate picture of the evolution of the wafer surface throughout the process sequence. We support our cleaning results with quasi in situ angle resolved X-ray Photoelectron Spectroscopy (XPS).

It was demonstrated that planar surfaces after oxide etching could be cleaned, leaving less than one monolayer of oxygen, fluorine, and carbon on the surface. The proposed cleaning process was also successful in removing contamination from both sidewalls and trench bottom in line and space patterned samples. The measured contact resistance after cleaning approached theoretical minimum.

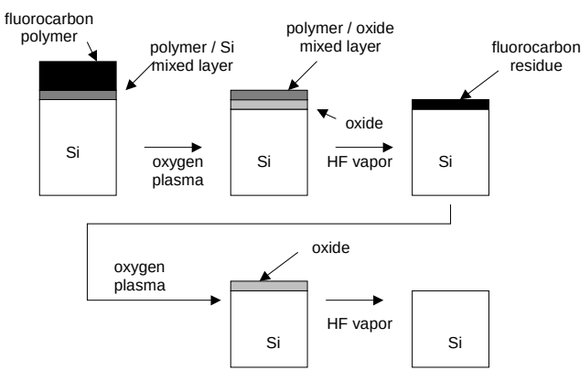

Figure 1 A schematic diagram of contaminated films and the proposed removal procedure.

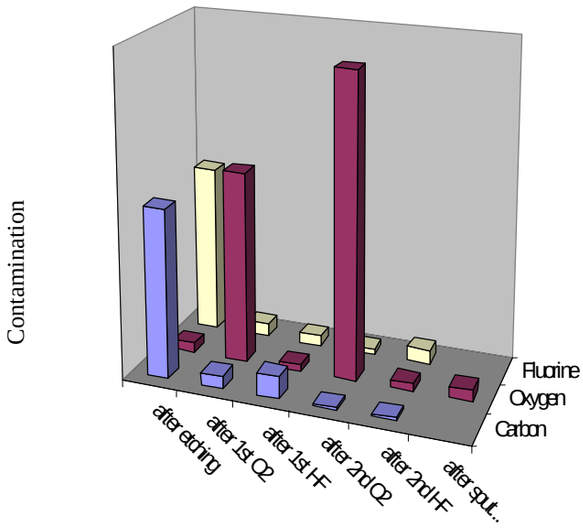

Figure 2 A histogram of contamination measured after each process steps. The integrated cleaning cleaned out the contaminated surface leaving less than half monolayer of contamination, which was subsequently removed by pre-sputter cleaning. Trace amount of oxygen left on the surface after sputter cleaning is captured during sample transfer

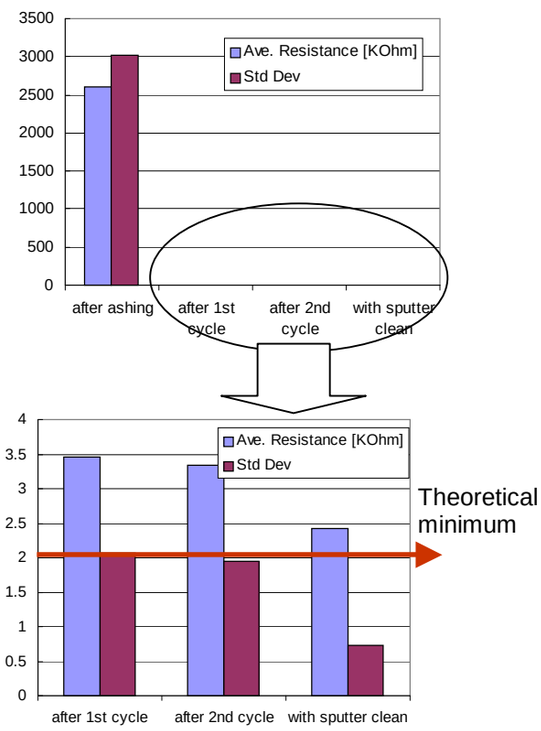

Figure 3 Contact resistance measured after each process steps. Use of oxygen plasma-HF cleaning integrated process reduced contact resistance close to the theoretical minimum value and pre-sputter cleaning reduced standard deviation of contact resistance distribution