CHARACTERISTICS OF NEUTRAL BEAM GENERATED BY A LOW ANGLE REFLECTION AND ITS ETCH CHARACTERISTICS BY HALOGEN-BASED GASES

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ABSTRACT

During the reactive ion etching, the devices are encountered by the species such as ultraviolet rays, energetic ions, etc. and the devices are damaged physically and electrically due to the energy and/or charge of the particles. Theses damages subjected by the energetic particles during the etching are generally removed by an annealing processing conducted during the device manufacturing process. However, as the device size shrinks to nanoscale, the annealing budget gets lower with decreasing device size, therefore, etching processes with less damaging the device are required for the nanoscale device processing.

For current reactive ion etching systems, even though physical damages can be significantly reduced by adjusting process parameters of the reactive ion etching, charge-related damages can not be solved when highly anisotropic etching is required. To avoid this charge-related damage, several low-damage processes have been proposed, and one of the techniques for avoiding this problem is to use neutral beam etching. A neutral beam is generally formed by producing reactive ions using a plasma source and, then neutralizing the ions during their extraction from the source. In our experiment, a neutral beam was formed by reflecting all the reactive ions extracted from an inductively coupled plasma (ICP) ion gun on a flat surface, tilted at a small angle from 5o to the ion beam direction, to produce a near-parallel neutral beam flux.

In this study, the characteristic of the neutral beam formed by the low angle reflection of the ion beam and the etch characteristics of semiconductor materials by the neutral beams generated by halogen-based gases were studied to investigate possible applications of the neutral beam to the charge-related damageless etching of semiconductor materials.