To search page

Early 1980s

Introduction of anisotropic plasma etching equipment (RIE)

~ Process Technology ~

In the isotropic etching which had been used up to this time, etching proceeded also in the lateral direction under the resist pattern, and the dimension of the space after etching spread beyond the resist pattern dimension. As miniaturization advanced, this phenomenon could not be ignored any longer around 1975 (3μm node), and anisotropic plasma etching (RIE) that realized the same etched pattern size as the mask pattern began to be used. As a result, miniaturization has advanced dramatically.
RIE is a method of introducing an etching gas into vacuum environment in which the wafer is placed, applying a high frequency electric field between an electrode on which a wafer is mounted and a counter electrode to generate plasma, and also by the aid of electric field generated at this time, the ions are drawn in the direction perpendicular to the wafer, realizing an anisotropic etching.
For RIE, there are four different types; (1) a parallel plate type (applying high frequency electric field to the parallel plates), (2) a magnetron type (increasing the density of plasma by applying a magnetic field), (3) an inductive coupling (ICP) type (generating plasma by induced electric field by the coil) and (4) high density plasma using electron cyclotron resonance (ECR).
Initially, parallel plate type equipment manufactured by semiconductor device manufacturers and their affiliated companies were used, but in the 1980s, specialized equipment manufacturers such as AMAT emerged. In Japan, Tokyo Electron, Nissei Sangyo (currently Hitachi High-Technologies) etc. entered the market, realizing high-speed and high-precision machines by high-density plasma using magnetron systems and ECR.
While RIE has become the driving force for advancing the high integration of LSI by miniaturization on one hand, on the other, the problems became apparent one after another such as electrostatic damage of the gate insulating film caused by charging of the wafer surface, variation in etching characteristics depending on pattern density differences, particle generation by deposition of byproducts. These problems have become steady tasks of equipment manufacturers and device manufacturers as well, along with the tasks accompanying with further miniaturization, enlargement of wafer diameters, improvement of productivity, and environmental measures.

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