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1978
Reactive Ion Etching (RIE) Equipment

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Reactive ion etching (RIE) was first developed by Nichiden Varian (later Nichiden Anelva, now Canon ANELVA) in 1974 [1], and reactive ion etching (RIE) equipment (DEA - 503) was put in the market. It was an equipment that held seven 100mm silicon wafers, and etched them using fluorocarbon type gases. In collaboration with ULSI Research Association, Nichiden Varian developed a multi-chamber type single wafer etching apparatus (DEA - 3016) with six process chambers. Nichiden Varian called this as reactive sputter etching, but RIE, which IBM later called, became the common name.

In semiconductor manufacturing, plasma etching by reactive gases had been used for resist removal and polysilicon etching. Etching by the neutral radicals in the reactive plasma gases is isotropic (etching speeds in the depth direction and the lateral direction are equal), so that etched cross section has an inclined angle. On the other hand, RIE is a method to use the principle of the sputtering and to apply an electric field in the direction perpendicular to the wafer and only ions in the plasma are used for etching. This enabled anisotropic etching, and the cross-sectional shape was made accurately aligned to the pattern size of the resist mask. Various methods in ion sources and ion controls were developed after this, and RIE became the basic method of semiconductor etching.

Figure 1 The first RIE Equipment (DEA-503)
(provided by Canon ANELVA Corporation)

Figure 2 The multi-chamber type single wafer RIE Equipment (DEA-3016)
(provided by Canon ANELVA Corporation)

References:

【1】N. Hosokawa, R. Matsuzaki and T. Asamaki “RF Spatter Etching by Fluoro-Chloro-Hydrocarbon Gases” Rroc. 6th International Vacuum Congress, Kyoto 1974

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