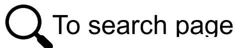

Early 1980s

Transition to formation of diffusion layers by ion implantation

~ Process Technology ~

In ion implantation equipment, elements such as group III boron (B), group V phosphorus (P), arsenic (As) are ionized, accelerated by high voltage, and injected into Si. The amount of impurities injected is given by the time integral of the ion beam current. Since the injected ions are stopped by repeated collision scattering with Si atoms, the implantation depth depends on the ion mass and acceleration energy.

In the 1970s, medium current ion implanters began to be used to control the threshold voltage of the MOS transistors and to prevent inversion of the Isolation region. And in the early 1980's, high-current implanters started to be used for the formation of highly doped diffusion layers of the MOS transistor source / drain. In order to inject impurities of high concentration in a short time, it was necessary to increase the ion beam current. The ion beam current, which was in the micro ampere order in the medium current ion implanter, was raised to the order of milliamperes in the high current ion implanter. Since the silicon single crystal structure at the portion through which the ions have passed is destroyed, it is necessary to restore it by heat treatment after implantation. While the crystallinity is restored by the heat treatment, at the same time, the implanted impurity elements enter the silicon lattice and are activated, and the impurity profile is determined with the effect of thermal diffusion. The advantages of the ion implantation method are; that it is a low temperature process, that the amount of implantation can be monitored, that selective impurities can be introduced using a photoresist as a mask, and that an arbitrary amount of impurities can be introduced.

Since the thermal diffusion method widely used by the early 1980s is driven by heat, it is difficult to independently control the surface concentration, the depth, and the concentration profile, and as the miniaturization progresses, the thermal diffusion method came to its limit to form shallow junctions.
As a full-scale mass-production high-current ion implanter, NOVA under EATON launched NV-10 in 1979, and in 1984 Sumitomo Eaton-nova, a joint venture between EATON and Sumitomo Heavy Industries started shipping the domestic machines, NV-10. In 1985, Applied Materials launched the fully automatic machine PI 9000.

Domestic ion implanter by Sumitomo Eaton-NOVA: NV-10

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