

1960

Epitaxial Growth Equipment

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Epitaxial growth method was developed by Gordon Teal and Howard Christensen of Bell Telephone Laboratories in 1951. In 1960, Henry Theurer of Bell Laboratory succeeded in growing a Si single crystal film on a Si substrate by chemical vapor deposition (CVD) by hydrogen reduction method of SiCl_4 . Starting with mesa type transistors, it became widely applied to integrated circuit (IC) process hereafter.

The initial epitaxial growth apparatus was with a mechanism that put a graphite substrate with a silicon wafer on it in a vertical quartz tube, heated it by high frequency induction heating, and introduced SiCl_4 and hydrogen gas. Later, with a horizontal quartz tube, a multiple silicon wafers were placed on a graphite substrate to increase the productivity.

Kokusai Electric (later Hitachi Kokusai Electric and now KOKUSAI ELECTRIC) developed a vertical epitaxial equipment (R-461) for single wafer processing for research and development use in 1962, and developed DC-1600 (Fig. 1) for production use which installed six 25 mm ϕ wafers in 1963. This was done by the request of a semiconductor device manufacture in Japan. In the latter half of the 1960s, Applied Materials developed an equipment with metal container (bell jar) or a pancake type epitaxial equipment, followed by Kokusai Electric.

Chemical vapor deposition (CVD) of SiO_2 and PSG (Phospho-Silicate Glass) films were started to be used in the latter half of 1960s, and similar type of equipment as pancake type epitaxial equipment were started to be sold by various companies.



Figure 1 Epitaxial Growth Equipment (DC-1600)
(provided by Kokusai Electric Corporation)