

## **Early 1960s**

### **Beginning of IC production in Japan**

#### **~ Integrated Circuit ~**

When mass production of transistors began in the 1950s, the idea of integrated circuits to form a plurality of transistors and diodes in one crystal came out. In 1952, Jeffrey Dammer in UK invented such an integrated circuit. In order to realize this integrated circuit, RCA's Micro Module, Molecular Electronics of Westinghouse, TI's Solid State Circuit, etc. were developed. The concept of an initial integrated circuit was close to a hybrid IC later rather than a monolithic IC. According to this concept, thin film integrated circuits that combined transistors and resistors and capacitors formed by vacuum evaporation on a substrate, and thick film integrated circuits in which resistors, capacitors, interconnects, and others were formed by printing method and integrated on a single ceramic substrate were developed.

Also in Japan, researchers who learned about the development of integrated circuits in the US started the development through trial and error. The team that succeeded in trial production first was a team led by Yasuo Tarui and Seiichi Denda of the Electrotechnical Laboratory. In December 1960, they succeeded in prototyping a product incorporating two transistors, two capacitors and two resistors on a germanium substrate.

At the same time Mitsubishi Electric was also developing Molelectron with reference to the sample of Molecular Electronics from Westinghouse, and it announced eleven kinds of Molelectron in February 1961. NEC also developed Micropacks for electronic telephone exchanges in 1961, and many Japanese manufacturers advanced the development of integrated circuits. However, at that time, the reliability of transistor itself was still not sufficiently high, and many problems such as reliability were found in integrated circuits.

The original source of current monolithic ICs was the silicon planar IC technology invented by Fairchild's Robert Noyce in 1959. With this technology, it became possible to stably form a plurality of elements on a silicon substrate. In 1963, NEC signed a patent agreement with Fairchild with exclusive license of planar patents. From this time on, in Japan, development of full-fledged IC corresponding to the current monolithic IC started. NEC actively pursued the development of silicon planar ICs, also conducted collaborative research with the University of Tokyo, and the results were presented at the conference of Electronic Communication Society of Japan in November 1963. From around 1965, products of silicon planar ICs such as DTL, TTL, and linear IC were commercialized by each company. Molelectron also shifted to monolithic IC.

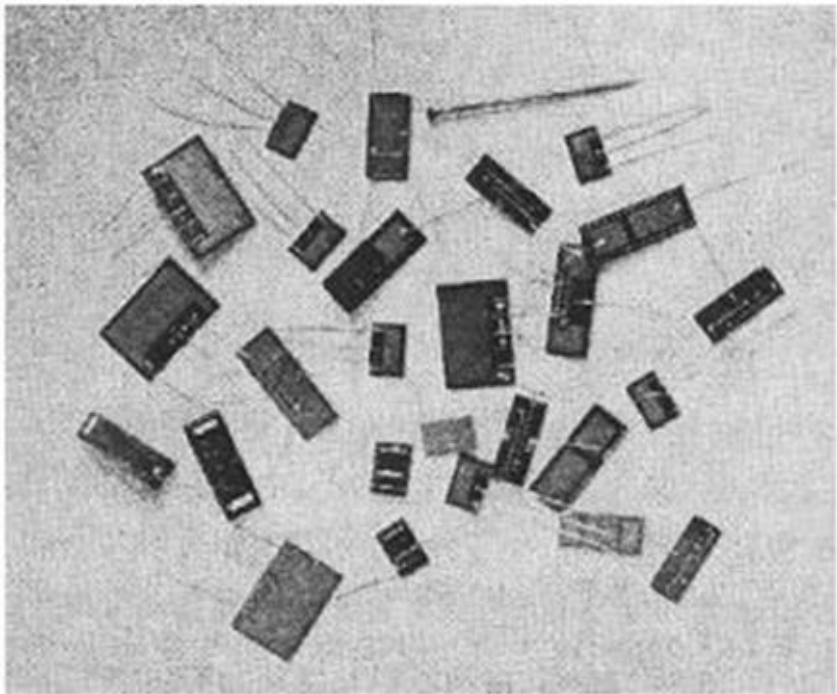


Fig.1: Picture of Mitsubishi's Molectrons

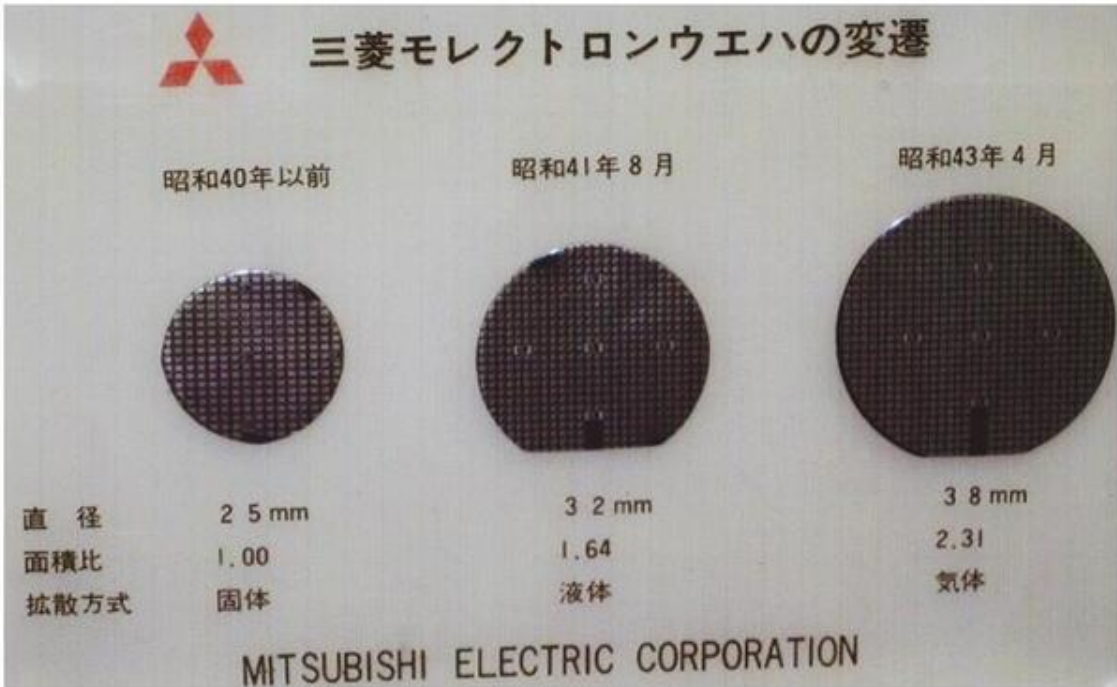


Fig.2: Evolution of Mitsubishi Molectron Wafers  
(By courtesy of Renesas Electronics)