

## Early 1980s

### **Advancing miniaturization requires the use of steppers in lithography**

#### **~ Process Technology ~**

In the 1980s, as the minimum pattern size became  $2\mu\text{m}$  and further reduced to  $1\mu\text{m}$ , steppers began to be used for mass production. Nikon launched the first commercial stepper NSR-1010G in 1980, and Canon also launched the commercial stepper FPA-1500FA in 1984, surpassing the performance of the preceding GCA machine. Since then, around 1995, Nikon and Canon occupied 70 to 80% of the semiconductor exposure equipment market share between them, and in its background, Japanese semiconductor device manufacturers such as Fujitsu, Toshiba, Hitachi, NEC, etc. dominated the DRAM market and led the semiconductor manufacturing equipment makers.

Miniaturization of pattern exposure is realized by shortening the wavelength of the exposing light and increasing the NA of the lens (NA is the numerical aperture, which can be understood as the size of the aperture of the lens) (for details see the section of "Late 1990's: Shortening of wavelength of exposure light source (from i-line to excimer laser light). In the 1980's, the exposure wavelength was g-line (wavelength 436 nm) emitted from an extra-high pressure mercury lamp, and in the 1990s it was shifted to i-line (wavelength 365nm) as the minimum dimension shifted from  $0.8\mu\text{m}$  to  $0.5\mu\text{m}$ .

In addition, most of the photoresist manufacturers were in Japan, and the development of the photoresists capable of fine pattern formation advanced at various companies. Various Japanese manufacturers such as Tokyo Ohka, JSR, Sumitomo Chemical and others supplied resists to the global market.



First Commercial Stepper in Japan: Nikon NSR-1010G