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Late 1990s
KrF excimer laser step-and-scan exposure system
~ Discrete Semiconductor/Others ~

The resolution of the i-line reduction- projection exposure system (stepper), which was the key equipment of the 1990s, was limited to 0.35 μm. Exposure techniques using a KrF laser with a wavelength of 248 nm had been studied since the 1980s. AT&T and Matsushita proposed a practical lithography technique using a KrF excimer laser as a light source in 1986. A KrF excimer laser for semiconductors manufacturing with stable output and long life was developed by Komatsu (later Gigaphoton) in 1987 and Cymer in 1988. KrF excimer laser steppers were developed by Nikon and ASML in the late 1980s.

On the other hand, the VLS chip size had also increased as patterns used in VLSI had been shrunk. Lithography had been required an expansion in the exposure area (field size). However, realization of both high NA and large aperture of the projection lens corresponding to short wavelength light had been considered to result in a significant cost increase. IBM, Toshiba, and Siemens, which had been collaboratively developing 256M DRAM, requested exposure system manufacturers to develop step-and-scan exposure system in order to achieve both high NA and large aperture of the projection simultaneously in 1992. There was an example that SVG developed 4:1 reduction-projection exposure system on the basis of the mirror projection type exposure system released by Perkin-Elmer in 1973, which scanned and exposed the photomask and wafer at the same time. Since the exposure was performed through the slit, the lens diameter was as small as about 0.7 times that of the stepper, and the field in the scanning direction was large. This system was called step-and-scan (scanner).

Nikon delivered a KrF excimer laser scanner (NSR-S201A) to IBM in 1995. NA was 0.6, resolution was 0.25 μm, and field size was 25 x 33 mm. Subsequently, ASML released the PAS5500 / 300 (1996), and Canon released the FPA-4000ES1 (1997). In 1998, Nikon released the KrF excimer laser scanner (NSR-S5203B), which expanded NA to 0.68 in order to achieve a resolution of 0.18 μm and was compatible with 300 mm wafers. The era of excimer laser scanners has arrived.

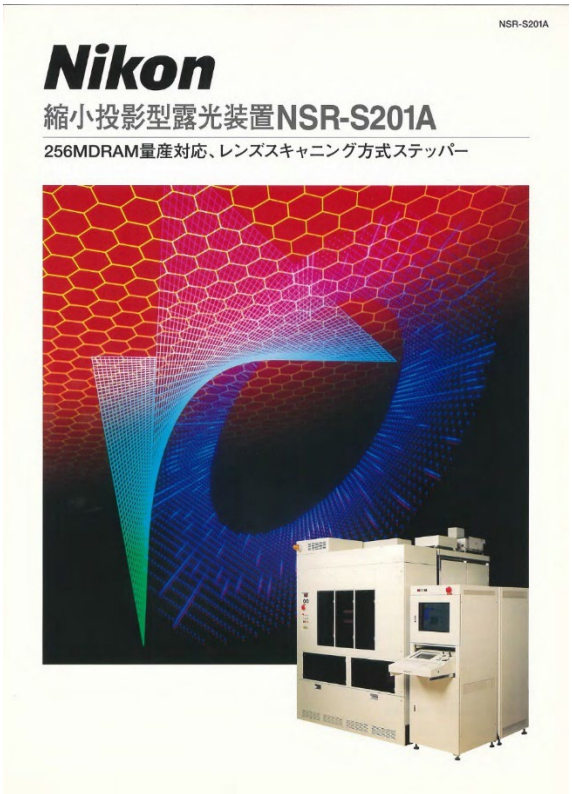

Figure 1 KrF excimer laser scanner NSR-S201A
(Courtesy of NIKON CORPORATION)

Figure 2　300mm KrF excimer laser scanner NSR-S203B
(Courtesy of NIKON CORPORATION)