Drawing

Semiconductors are used in all sorts of devices, from Smartphones and games to personal computers, appliances, and automobiles.
Of the various processes used in manufacturing semiconductor devices, the most important is photolithography, the process of creating the fine patterns that form the circuits.
In this tiny, nano-level world, Ushio light plays a big role.

Photolithography: The main process of semiconductor manufacture

Building on the principle used to photographically replicate original documents on printing paper, light is employed to create the paths used to fabricate circuits on substrates such as silicon wafers or glass. This process is referred to as “photolithography” (Figure 1). Aluminum or copper embedded into the channels transferred from a circuit pattern to a substrate becomes the “wiring” through which electricity travels. The finer the lines of this “wiring,” the smaller the elements making up the heart of electronic components and the more compact the chips that can be produced or the greater the functionality and performance that can be achieved.

What determines the line width that can be achieved is the wavelength of light. As shorter wavelengths allow reproducing lines of finer width, the wavelengths of the lamps used as light sources have become shorter and shorter, starting with lamps of 365 to 436 nm, then moving down to excimer lasers with wavelengths of 193 to 248 nm, and then to 13.5 nm EUV light sources. The process of photolithography is extremely subtle work which could be compared to taking the 23 wards of Tokyo, dropping them into a 30-km circle, and then drawing innumerable lines with a width of 0.1 mm onto the circle, and then repeating the process with multiple layers of colored drawings to create an electronic circuit of exceeding complexity.

From light source to device components, developed entirely by Ushio

Reproduction of such finely detailed electronics circuits requires not only a stable, high-energy light source of the appropriate wavelength for exposure, but optical technology including mirrors and lenses that are capable of efficiently condensing light emitted by the lamp and projecting it with a high degree of uniformity and collimation, transport technology appropriate for carrying the wide variety of hard glass or film types onto which the light is projected (the substrates), the alignment technology necessary to position substrates of dimensions exceeding 10 cm with precision on the order of a few microns, and the software technology necessary to control all of these processes. And of course all of these elements must be combined into a well-balanced system.

Beginning with development and production of UV lamps for use with the photolithography systems used in manufacture of the first integrated circuits in the 1960s, Ushio has gone on to develop all of its own core technologies for such equipment, making possible the development of photolithography systems (exposure systems) of its own. With its ability to optimize operation according to the type of device being manufactured, Ushio’s exposure now plays a role around the world.

It now plays an indispensable role in the production of the digital devices that have come to play such an essential role in our daily lives. Such are Ushio’s UV lamps and exposure systems for ‘photolithography’.

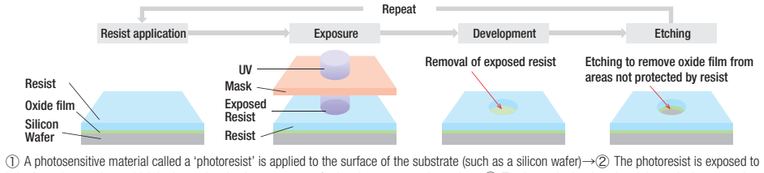
Common platform

+

Ushio’s UX Series exposure system
Using core technology developed and owned entirely by Ushio, this system fulfills all the requirements for a final device used in production of a variety of sensors, power semiconductors, and LEDs.

“Drawing with light” The Mechanism

Fig. 1 Photolithography process diagram



① A photosensitive material called a ‘photoresist’ is applied to the surface of the substrate (such as a silicon wafer)→② The photoresist is exposed to light through a mask on which is drawn the circuit pattern, transferring the pattern to the resist→③ The image is developed and the resist is removed→④ The oxide film underlying the resist is removed by etching and the circuit is formed in the etched pattern. **The process is repeated with a variety of masks in a series of operations to build up a complex 3-dimensional circuit.**