

A Two-dimensional Light Intensity Simulator:TWAIN

A. Moniwa, T. Ito☆, A. Sugimoto★

HITACHI Ltd. Central Res. Lab., Hitachi Res. Lab.☆, Musashi Works★

1-280 Higashikoigakubo, Kokubunji-shi, Tokyo 185

☆4026 Kuji-cho, Hitachi-shi, Ibaraki 319-12

★1450 Josuihon-cho, Kodaira-shi, Tokyo 187

A photolithography simulation based on Dill's model (1) is composed of three simulations: light intensity simulation, photosensitizer concentration simulation, and development simulation. In those three simulations, the 2-dimensional light intensity simulation takes most of calculation time. Therefore, a light intensity simulator TWAIN (Two-dimensional Aerial image Intensity simulator) has been developed to obtain short cpu time.

Conventionally, the light intensity distribution was obtained by calculating fourfold integral according to Lin's model (2). However, Fast Fourier Transform is more suitable for vector processors than fourfold integral, because of the parallel processing feature. Flow chart of TWAIN is shown in Fig. 1. TWAIN is based on Yeung's model (3) which assumes to divide the illumination source into a number of point source elements, and the image of each point source element is obtained with FFT.

A light intensity distribution of memory cell is calculated by TWAIN as shown in Fig. 2. The calculation time for the light intensity was about 5 minutes on a HITAC S-810 super computer. It became 1/10 of conventional light intensity simulation according to Lin's model. The developed image in Fig. 2 by three dimensional photoresist imaging simulator TRIPS (4) is shown in Fig. 3 and a scanning electron micrograph of an actual photoresist image is shown in Fig. 4. There is good agreement between the simulated and actual images.

(1) F. H. Dill, IEEE ED-22, p. 456, 1975.

(2) B. J. Lin, IEEE ED-27, p. 931, 1980.

(3) M. Yeung, Proc. Kodak ME Seminar INTERFACE'85, p. 115, 1986.

(4) A. Moniwa, IEEE CAD-6, p. 431, 1987.

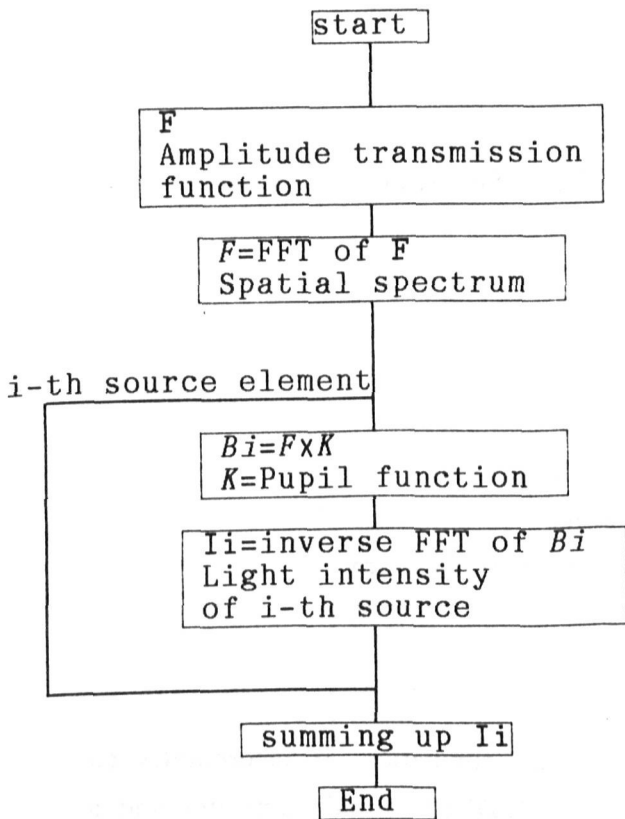


Fig.1 Flowchart of TWAIN

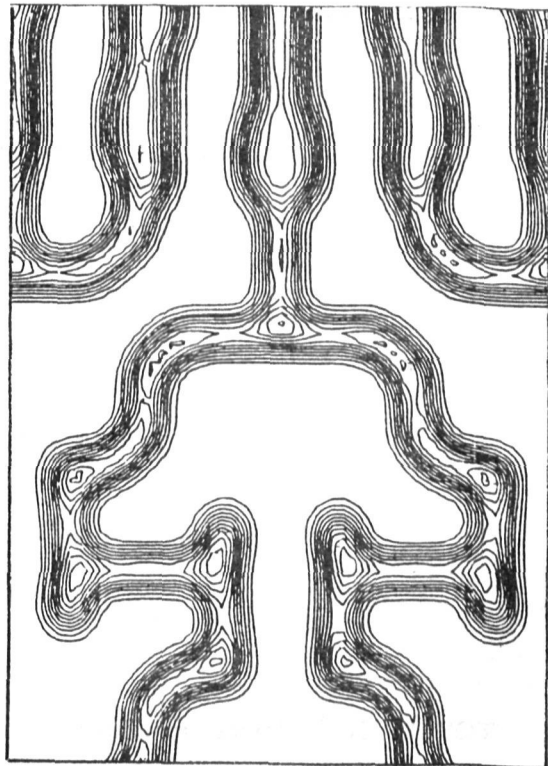


Fig.2 A light intensity distribution of a memory cell

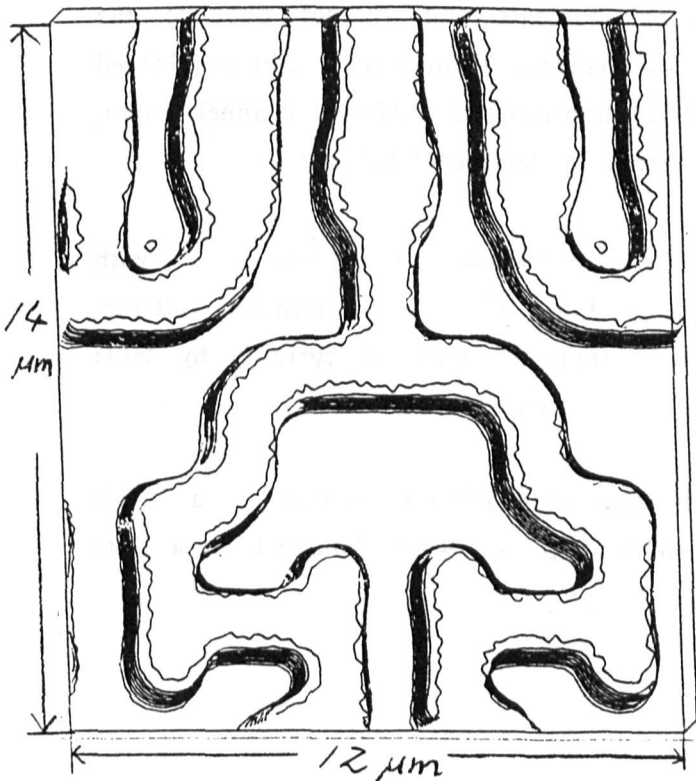


Fig.3 A developed resist image

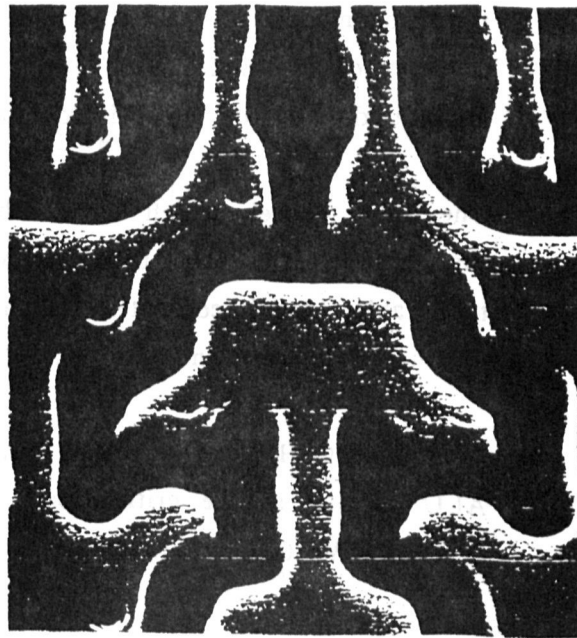


Fig.4 A scanning electron micrograph