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Computer Controlled Direct Pattern Writing by Argon Laser Induced Chemical Vapor Deposition

Akira Ishizu, Hidejiro Miki, Yoichiro Onishi
Materials & Electronic Devices Lab.,Mitsubishi Electric
Tadashi Nishimura, Yoichi Akasaka
LSI Research & Development Lab., Mitsubishi Electric

In recent years, laser-induced chemical vapor deposition (LCVD) has been developed extensively as a remarkable technology of thin film deposition. Now this technology is paid much attention because the capability of selectively patterned film deposition will grow the novel technologies such as mask reparation, writing redundant circuits and fabrication of thin film transistors for flat display. From this point of view, we have developed the novel LCVD equipment with the ability of direct pattern writing according to the previously programmed data.

In this report, we present the outline of this equipment and the results of initial experiments on direct pattern writing by thermal decomposition of SiH_4 with an argon laser.

Figure 1 is the schematic diagram of this equipment. A CW argon laser beam with output power of 20 W is irradiated perpendicularly onto a wafer through 20 mm thick quartz window. Personal computer controls beam ON-OFF modulator and scanning speed of the X-Y stage according to the programmed data. We can set the beam positioning and beam irradiation conditions by the ITV moniter system. Typical focal spot diameter is 20 μm with a positioning accuracy of 1 μm. Beam scanning speed can be varied from 10 to 150 mm/s. In this LCVD, the argon laser beam is used to provide localized heating of the substrate in order to decompose gas phase molecules, resulting in film deposition.

Figure 2 shows the optical microscopic view of the example of direct pattern writing of silicon. The samples were (100) silicon with surface covered by 1.1 μm of thermally grown SiO_2.

Typical LCVD conditions were beam scan speed of 10 mm/s, substrate temperature of 400 °C and deposition pressure of 200 Torr SiH_4. 1 mm long and 30 μm wide selective deposited area were orderly arranged and clearly controlled according to the data.

As shown in Fig.3, these deposited lines were formed of gathering of cone shaped nuclei. Thickness of these deposited lines were about 2 μm and growth rate was 1000-2000 μm/s.

From these results, we can say it possible to realize the selective laser-induced chemical vapor deposition of silicon making use of argon laser.

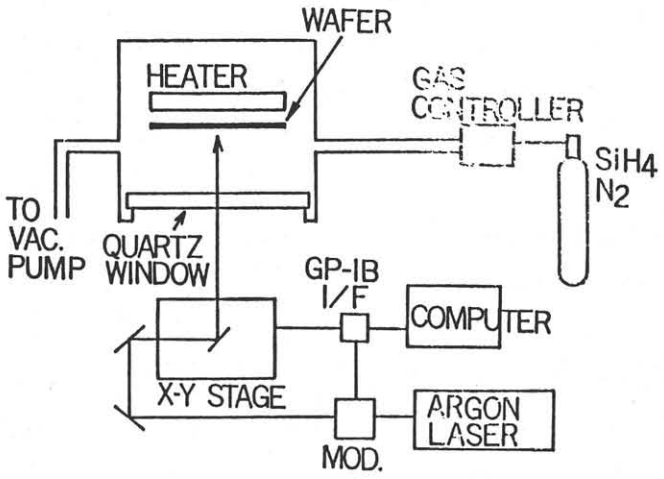

Fig.1 Schematic diagram of equipment

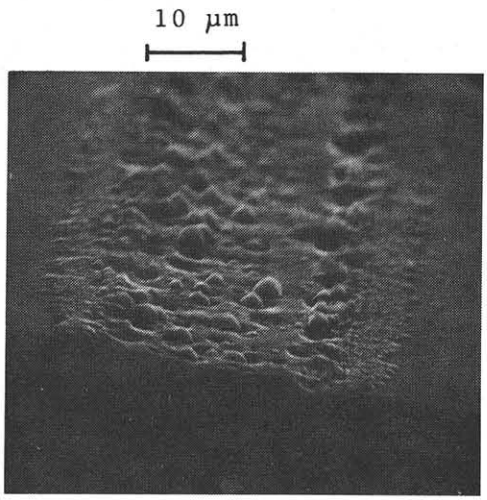

Fig.3 SEM micrograph of deposited Si line

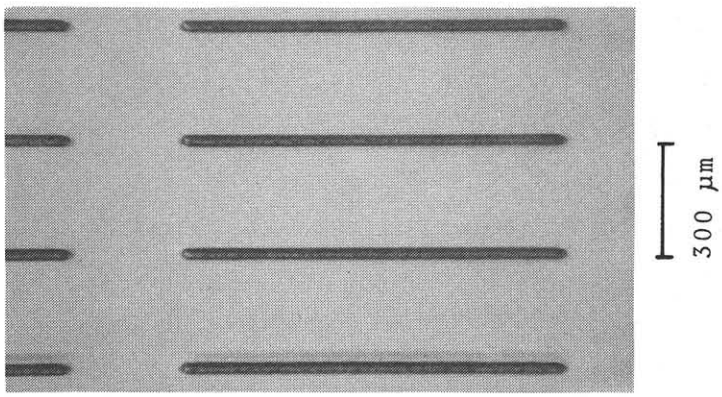

Fig.2 Microscopic view of deposited Si line