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Laser Application in Semiconductor Processing

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Recent progress of the laser application in semiconductor processing is discussed. The continuous increase of device density in microelectronics requires the higher resolution in the device fabrication technology. In photolithography the resolution is proportional to the wavelength and the inverse of the numerical aperture. Thus the resolution is inherently limited by the wavelength of light source. Nevertheless, the optical lithography is expected to be applied in the future device technology since it has many advantages compared to the alternative processes. Mask problem in x-ray lithography and low through-put in the direct writing process in electron beam lithography are considered to be main problems.

With the advent of excimer laser application in photolithography the optical process now comes to believe to be a powerful technique in submicron region. The half micron pattern was for the first time carried out by using ArF excimer laser. Recent progress of projection technique of KrF excimer laser has revealed the breakthrough in photolithography The performance of projection system of KrF excimer laser(248nm)using quartz lens with high numerical aperture and the large field size compatible to large integrated circuit will be discussed. The problems contained in excimer laser lithography are such as lens system, transparent materials as well as he successive performance of excimer laser itself

Photochemical processing is also attractive as the device process. The chemical vaper deposition is widely recognized as an effective technique for thin film deposition. In the typical procedures, the chemical vapor deposition is accomplished by heating the substrate in a reactive atmosphere. In the device technology in the future, it is important to reduce the temperature. The photochemical processing provides the radical production by nonthermal photolytic reaction. The low temperature deposition process is considerable interest because in this way one can reduce dopant redistribution, wafer warpage and defect generation as well as being capable of layered resist in high resolution lithography.

Furthermore, much attention has been paid in the laser doping process. The laser pulse serves both to release the dopant atoms near the semiconductor substrate by photolysis of gas phase or adsorbed parent gas molecule and, simultaneously, to melt the surface of the substrate to allow incorporation of the dopant. The ultra-shallow distribution of the dopant is obtained using short wavelength and short pulse excimer laser beam The electrical properties and the depth profile of silicon atom in GaAs by the irradiation of XeCl excimer laser(308nm) will be discussed.