POLY-SI, SI-TRENCH ETCH

Poly-Si	Gases	$SiCl_4$	30 sccm
		Cl_2	5-10 sccm
		$CHCl_3$	0-5 sccm
	Pressure		20-30mT
	R. F.		120-150W
	d.c.		150-250V
	Susceptor		Al_2O_3
	Endpoint		laser
			O.E. @ 725.4nm (Cl)
	Gas Channels	0-100 $SiCl_4$	($SiCl_4$)
		0-100 Cl_2	(Cl_2)
		0-100 $CHCl_3$	($CHCl_3$)
	Poly-Si etch rate		500-1500Å/min.
	Selectivity to SiO_2		10-20:1
	Selectivity to photo-resist		2-3:1
	profile		anisotropic

POWER

Poly-Si etch rate increases with increasing power. Highest selectivity to SiO_2 generally occurs at lowest power (low d.c.) levels. Etch rate is also dependent on poly-Si doping level.

PRESSURE

Over a small range, pressure has little influence on the process.

GAS FLOW

Increasing Cl_2 flow will increase poly-Si etch rate. At high flows, profile becomes isotropic. Because process is somewhat load dependent, high Cl_2 flow can be used initially, and lower Cl_2 flow at end-point and for over-etch. $CHCl_3$ may be necessary to obtain anisotropic profile for highly doped poly-Si.

Si-trench	Gases	BCl_3	10 sccm
		$SiCl_4$	30 sccm
		Cl_2	10 sccm
	Pressure		30-50mT
	R. F.		150-200W
	d.c.		200-300V
	Susceptor		Al_2O_3
	Endpoint		time (laser*)
	Gas Channels	0-100 BCl_3	(BCl_3)
		0-100 $SiCl_4$	($SiCl_4$)
		0-100 Cl_2	(Cl_2)
Single Crystal Si etch rate			750-1000Å/min.
Selectivity to SiO_2			10-15:1
profile			anisotropic (85°-90° slope)

POWER

Silicon etch rate increases with power, and profile is more vertical at higher power (higher d.c.) levels. However selectivity to SiO_2 decreases with increasing power. Power is limited by depth of etch required and mask thickness.

PROFILE

Although the etch is essentially anisotropic small changes in power, pressure and gas flow will subtly affect the wall profile. This becomes most evident in narrow, deep trenches when ion reflections from the walls and shadowing effects can produce compound angular features.

SURFACE MORPHOLOGY

Ideally the etched Si surface maintain a smooth, mirror-like finish. Because the process is so anistropic any contaminants which can act as a mask will give rise to high aspect ratio "spikes". In severe cases these "spikes" are so dense that the surface will appear completely rough (black silicon). This can be minimized by careful pre-cleaning of the wafers, although attention must also be paid to the mask etch and to the quality of the silicon substrate used.

ENDPOINT

As there is no etch stop with this process etching is normally done on a time basis to achieve a given etch depth. If the mask is appropriate (approx. 50/50 open/masked area) then a laser can be used to monitor etch depths greater than approx. 2000Å.