

Commercial Wafer Specifications

Illustration

Here are the specification for **Si** wafers from one of the worlds top companies, **Wacker Siltronic**, as they appear in the Internet in Nov. **2000**.

Notice: Concentrations here are in cm^{-3} . The conversion to **part per million (ppm)** is simple: orrelation

The atomic density of Si is $4.96 \cdot 10^{22} \text{ cm}^{-3}$ or about $5 \cdot 10^{22} \text{ cm}^{-3}$. This gives us

$$1 \text{ ppm} = 5 \cdot 10^{16} \text{ cm}^{-3}$$

The lowest concentration given in the table (look for it) is $5 \cdot 10^{10} \text{ cm}^{-3}$; it corresponds to **1 ppt** or 10^{-12} .

Surface concentrations **[S]** (given in cm^{-2}) are converted to volume concentrations [V] by

$$[S] = \frac{[V] \cdot a}{1}$$

With **a** = lattice constant (= **0,5431 nm**) or, more precise for single crystals, distance between the crystallographic planes. With **a** approximately **0,5 nm = $5 \cdot 10^{-8} \text{ cm}$** , we have **[V] = $5 \cdot 10^{16} \text{ cm}^{-3}$ = 1 ppm** corresponds to **S = 10^8 cm^{-2}**

Many specifications relate to the "flatness" of the wafers and the perfection of the surface; the abbreviations used are

LLS (sometimes also abbreviated **LPDs**): **Localized Light Scattering Defect**; this relates to a detection method of sub- μm size surface imperfections (resulting from bulk microdefects)

SFQR: Site flatness quality requirements (??): Whatever it means in detail - definitely a measure of flatness in a region comparable to the size of a single chip.

(The rest: Who knows - to be included later)

Polished & Epitaxial Wafers for IC Applications

Crystal / Bulk			300mm	200mm	150mm	125mm	100mm
Growth Technique *)			CZ	CZ	CZ	CZ	CZ
Orientation			1-0-0	1-0-0	1-0-0 / 1-1-1	1-0-0 / 1-1-1	1-0-0 / 1-1-1
Orientation Tolerance		degree	± 0.2	± 0.2	± 0.5	± 0.5	± 0.5
Off Orientation		degree	0	0 - 4	0 - 4	0 - 4	0 - 4
Dopant			Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus
Resistivity Target Range	pol prime - Boron	Ohmcm	0.5 - 50	0.5 - 50	0.5 - 50	0.5 - 50	0.5 - 50
	pol prime - Phosphorous	Ohmcm	1.0 - 50	1.0 - 50	1.0 - 50	1.0 - 50	1.0 - 50
	epi substrate - Boron	Ohmcm	0.006 - 50	0.006 - 50	0.006 - 50	0.006 - 50	0.006 - 50
Radial Resistivity Variation	Boron typical 1-0-0 / 1-1-1	%	< 10	< 5	< 5 / < 6	< 6 / < 10	< 8 / < 9
	Phosph. typical 1-0-0 / 1-1-1	%	< 15	< 15	< 12 / < 25	< 12 / < 25	< 15 / < 25
Oxygen Target Range \pm Tol.	pol prime - Boron 1-1-1	at cm^{-3}	$4.8 - 7.8 \times 10^{11} \pm 0.5$	$5 - 7.8 \times 10^{11} \pm 0.5$	$5.8 - 8.9 \times 10^{11} (\pm 0.6 - 0.8)$	$5.8 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.8 - 8.9 \times 10^{11} (\pm 0.8 - 1.2)$
	1-1-1		NA	NA	$5.8 - 8.9 \times 10^{11} (\pm 0.7 - 1.0)$	$6.2 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.9 - 8.9 \times 10^{11} (\pm 0.8 - 1.5)$
	pol prime - Phosph. 1-0-0	ASTM F121-83	$4.8 - 7.8 \times 10^{11} \pm 0.5$	$6 - 7.5 \times 10^{11} \pm 0.5$	$5.8 - 8.9 \times 10^{11} (\pm 0.6 - 0.8)$	$5.8 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.8 - 8.9 \times 10^{11} (\pm 0.8 - 1.2)$
	1-1-1		NA	NA	$5.8 - 8.9 \times 10^{11} (\pm 0.7 - 1.0)$	$6.2 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.9 - 8.9 \times 10^{11} (\pm 0.8 - 1.5)$
Radial Oxygen Variation	typical	%	< 10	< 5	< 6	< 6	< 5 - 10
Bulk Metal Concentration	Fe	at cm^{-3}	$\leq 5.0 \times 10^{10}$	$\leq 5.0 \times 10^{10}$	$\leq 1.0 \times 10^{11}$	$\leq 1.0 \times 10^{11}$	$\leq 1.0 \times 10^{11}$
Bulk Carbon Concentration	measured on wafer	at cm^{-3}	$\leq 2.0 \times 10^{10}$	$\leq 2.0 \times 10^{10}$	$\leq 2.0 \times 10^{10}$	$\leq 2.5 \times 10^{10}$	$\leq 2.5 \times 10^{10}$
Polished Wafers / Substrates			300mm	200mm	150mm	125mm	100mm
Surface Metals	Cu / Cr / Fe / Ni	at cm^{-2}	$\leq 1.0 \times 10^{10}$	$\leq 2.5 \times 10^{10}$	$\leq 5.0 \times 10^{10}$	$\leq 5.0 \times 10^{10}$	$\leq 5.0 \times 10^{10}$
	Al / Zn / K / Na / Ca	at cm^{-2}	$\leq 5.0 \times 10^{10}$	$\leq 1.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$
LLSs (Frontside) *)	size	μm	> 0.2 > 0.16 > 0.12	> 0.2 > 0.16 > 0.12	> 0.3 > 0.2 > 0.12	> 0.3 > 0.2 > 0.12	> 0.3 > 0.2 > 0.12
	pol prime	# per wafer	< 30 < 40-300 < 200-10*	< 15-35 < 20-120 < 70-600	< 15 < 30 NA	< 15 < 30 NA	< 15 < 30 NA
	UltraFlat (150 mm)	# per wafer	NA NA NA	NA NA NA	< 5 < 10 < 150	NA NA NA	NA NA NA
	monitor	# per wafer	< 30 < 60 < 100	< 15 < 20-65 < 130-700	NA NA NA	NA NA NA	NA NA NA
Diameter Tolerance		mm	± 0.2	± 0.2	± 0.2	± 0.2	± 0.2
Warp	polished - without layer	μm	< 50	< 20	< 30	< 30	< 30
Wafer / Substrate Thickness	Standards	μm	775	725	375 / 525 / 625 / 675	375 / 525 / 625	300 / 375 / 525
Thickness Tolerance		μm	± 25	± 15	± 15	± 15	± 15
GBIR = TTV (Std UltraFlat) *)		μm	< 4	< 3.5	< 5.0 < 2.5	< 5.0 < 2.5	< 5.0 < 2.5
GFLR = TIR (Std UltraFlat) *)		μm	NA	< 2.0	< 2.0 < 7.2	< 2.0 < 7.2	< 2.0 < 7.2
Local Flatness *)	SFQR / STIRmax, s.b.f.	μm	< 0.25	< 0.25	< 0.5 < 0.3	NA NA	NA NA
	SFOD / SFDP, s.b.f.	μm	< 0.18	< 0.18	< 0.3 < 0.2	NA NA	NA NA
	SBIR / STIRmax, b.r.	μm	NA	< 0.7	< 1.0 < 0.6	< 1.0 < 0.6	< 1.0 < 0.6
Standard Site Size		mm ²	25 x 25	25 x 25	15 x 15	15 x 15	15 x 15