

Commercial Wafer Specifications

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 parts per .. is simple:
The atomic density of Si is $4.96 \cdot 10^{22} \text{ cm}^{-3}$ or about $5 \cdot 10^{22} \text{ cm}^{-3}$.
1 ppm thus corresponds to $5 \cdot 10^{16} \text{ cm}^{-3}$.
- 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] = [V] / a with **a** = lattice constant (= **0,5431 nm**) or, more precise for single crystals, distance between the crystallographic planes. With **a** $\approx$ **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** (??): Definitely a measure of flatness in a region comparable to the size of a single chip
(The rest: Who knows?)
- Here is a link with precise defininitioons of geometricla parameters:
http://www.freiberger.com/english/products/geom_parameters.php

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 / < 6	< 8 / < 9	< 8 / < 9	
	Phosph. typical	1-0-0 / 1-1-1	%	< 15	< 15	< 12 / < 25	< 15 / < 25	
	pol prime - Boron	1-0-0		4.8 - 7.8 x 10 ¹¹ ± 0.5	5 - 7.8 x 10 ¹¹ ± 0.5	5.8 - 8.9 x 10 ¹¹ (± 0.6 - 0.8)	5.8 - 8.9 x 10 ¹¹ (± 0.5 - 1.0)	5.8 - 8.9 x 10 ¹¹ (± 0.8 - 1.2)
Oxygen Target Range ± Tol.		1-1-1	at cm ⁻³	NA	NA	5.8 - 8.9 x 10 ¹¹ (± 0.7 - 1.0)	6.2 - 8.9 x 10 ¹¹ (± 0.5 - 1.0)	5.9 - 8.9 x 10 ¹¹ (± 0.8 - 1.5)
	pol prime - Phosph.	1-0-0	ASTM F121-83	4.8 - 7.8 x 10 ¹¹ ± 0.5	6 - 7.5 x 10 ¹¹ ± 0.5	5.8 - 8.9 x 10 ¹¹ (± 0.6 - 0.8)	5.8 - 8.9 x 10 ¹¹ (± 0.5 - 1.0)	5.8 - 8.9 x 10 ¹¹ (± 0.8 - 1.2)
		1-1-1		NA	NA	5.8 - 8.9 x 10 ¹¹ (± 0.7 - 1.0)	6.2 - 8.9 x 10 ¹¹ (± 0.5 - 1.0)	5.9 - 8.9 x 10 ¹¹ (± 0.8 - 1.5)
Radial Oxygen Variation	typical	%	< 10	< 5	< 6	< 6	< 5 - 10	
Bulk Metal Concentration	Fe	at cm ³	≤ 5.0 x 10 ¹⁰	≤ 5.0 x 10 ¹⁰	≤ 1.0 x 10 ¹¹	≤ 1.0 x 10 ¹¹	≤ 1.0 x 10 ¹¹	
Bulk Carbon Concentration	measured on wafer	at cm ³	≤ 2.0 x 10 ¹⁰	≤ 2.0 x 10 ¹⁰	≤ 2.0 x 10 ¹⁰	≤ 2.5 x 10 ¹⁰	≤ 2.5 x 10 ¹⁰	

Polished Wafers / Substrates			300mm	200mm	150mm	125mm	100mm
Surface Metals	Cu / Cr / Fe / Ni	at cm ²	≤ 1.0 x 10 ¹¹	≤ 2.5 x 10 ¹¹	≤ 5.0 x 10 ¹¹	≤ 5.0 x 10 ¹¹	≤ 5.0 x 10 ¹¹
	Al / Zn / K / Na / Ca	at cm ²	≤ 5.0 x 10 ¹¹	≤ 1.0 x 10 ¹¹	≤ 2.0 x 10 ¹¹	≤ 2.0 x 10 ¹¹	≤ 2.0 x 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	> 0.3
	pol prime	# per wafer	< 30 < 40-300 < 200-10 ¹	< 15-35 < 20-120 < 70-600	< 15 < 30 NA	< 15	< 15
	UltraFlat (150 mm)	# per wafer	NA NA NA	NA NA NA	< 5 < 10 < 150	NA	NA
	monitor	# per wafer	< 30 < 60 < 100	< 15 < 20-65 < 130-700	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
GFLR = TIR (Std UltraFlat) *)		µm	NA	< 2.0	< 2.0	< 1.2	< 2.0
Local Flatness *)	SFQR / STIRmax, s.b.f.	µm	< 0.25	< 0.25	< 0.5	< 0.3	NA
	SFQD / SFPD, s.b.f.	µm	< 0.18	< 0.18	< 0.3	< 0.2	NA
	SBIR / STIRmax, b.r.	µm	NA	< 0.7	< 1.0	< 0.6	< 1.0
Standard Site Size		mm ²	25 x 25	25 x 25	15 x 15	15 x 15	15 x 15