

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 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 $\approx 0,5 \text{ nm} = 5 \cdot 10^{-8} \text{ cm}$** , we have **[V] = $5 \cdot 10^{16} \text{ cm}^{-3} = 1 \text{ ppm}$** 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 definitions of geometrical parameters:
http://www.freiberger.com/english/products/geom_parameters.php

Polished & Epitaxial Wafers for IC Applications			300mm	200mm	150mm	125mm	100mm	
Crystal / Bulk			CZ	CZ	CZ	CZ	CZ	
Growth Technique *)			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			± 0.2	± 0.2	± 0.5	± 0.5	± 0.5	
Orientation Tolerance		degree	0	0 - 4	0 - 4	0 - 4	0 - 4	
Off Orientation		degree	Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus	Boron / Phosphorus	
Dopant			0.5 - 50	0.5 - 50	0.5 - 50	0.5 - 50	0.5 - 50	
Resistivity Target Range	pol prime - Boron	Ohmcm	1.0 - 50	1.0 - 50	1.0 - 50	1.0 - 50	1.0 - 50	
	pol prime - Phosphorous	Ohmcm	0.006 - 50	0.006 - 50	0.006 - 50	0.006 - 50	0.006 - 50	
	epi substrate - Boron	Ohmcm						
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	< 15 / < 25	< 15 / < 25
Oxygen Target Range \pm Tol.	pol prime - Boron	1-0-0	at cm^3	$4.8 - 7.8 \times 10^{11} \pm 0.5$	$5 - 7.8 \times 10^{11} \pm 0.5$	$5.8 - 8.9 \times 10^{11} (\pm 0.6 - 0.8)$	$5.8 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.8 - 8.9 \times 10^{11} (\pm 0.8 - 1.2)$
	pol prime - Phosph.	1-1-1	at cm^3	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	$4.8 - 7.8 \times 10^{11} \pm 0.5$	$6 - 7.5 \times 10^{11} \pm 0.5$	$5.8 - 8.9 \times 10^{11} (\pm 0.6 - 0.8)$	$5.8 - 8.9 \times 10^{11} (\pm 0.5 - 1.0)$	$5.8 - 8.9 \times 10^{11} (\pm 0.8 - 1.2)$
Radial Oxygen Variation	typical	1-1-1	%	< 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	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.5 \times 10^{11}$	$\leq 2.5 \times 10^{11}$
Polished Wafers / Substrates			300mm	200mm	150mm	125mm	100mm	
Surface Metals	Cu / Cr / Fe / Ni		at cm^2	$\leq 1.0 \times 10^{11}$	$\leq 2.5 \times 10^{11}$	$\leq 5.0 \times 10^{11}$	$\leq 5.0 \times 10^{11}$	$\leq 5.0 \times 10^{11}$
	Al / Zn / K / Na / Ca		at cm^2	$\leq 5.0 \times 10^{11}$	$\leq 1.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$	$\leq 2.0 \times 10^{11}$
LLSs (Frontside *)	size		μm	> 0.2 > 0.16 > 0.12	> 0.2 > 0.16 > 0.12	> 0.3 > 0.2 > 0.12	> 0.3	> 0.3
	pol prime	# per wafer		< 30 < 40-300 < 200-10*	< 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