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 $\mathbf{cm^{-3}}$. The conversion to **part per milion (ppm)** is simple:orrelation
- The atomic density of Si is $\mathbf{4.96 \cdot 10^{22}\ cm^{-3}}$ or about $\mathbf{5 \cdot 10^{22}\ cm^{-3}}$. This gives us

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

- The lowest concentration given in the table (look for it) is $\mathbf{5 \cdot 10^{10}\ cm^{-3}}$; it corresponds to **1 ppt or** $\mathbf{10^{-12}}$.
- Surface concentrations **[S]** (given in $\mathbf{cm^{-2}}$) are converted to volume concentrations **[V]** by

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

- 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· 10^{-8} cm**, we have
  [V] = 5 · 10^{16} 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 ± Tol.	pol prime - Boron 1-0-0		4.8 - 7.8 x 10^{17} ± 0.5	5 - 7.8 x 10^{17} ± 0.5	5.8 - 8.9 x 10^{17} (± 0.6 - 0.8)	5.8 - 8.9 x 10^{17} (± 0.5 - 1.0)	5.8 - 8.9 x 10^{17} (± 0.8 - 1.2)
	1-1-1	at cm^{-3}	NA	NA	5.8 - 8.9 x 10^{17} (± 0.7 - 1.0)	6.2 - 8.9 x 10^{17} (± 0.5 - 1.0)	5.9 - 8.9 x 10^{17} (± 0.8 - 1.5)
	pol prime - Phosph. 1-0-0	ASTM F121-83	4.8 - 7.8 x 10^{17} ± 0.5	6 - 7.5 x 10^{17} ± 0.5	5.8 - 8.9 x 10^{17} (± 0.6 - 0.8)	5.8 - 8.9 x 10^{17} (± 0.5 - 1.0)	5.8 - 8.9 x 10^{17} (± 0.8 - 1.2)
	1-1-1		NA	NA	5.8 - 8.9 x 10^{17} (± 0.7 - 1.0)	6.2 - 8.9 x 10^{17} (± 0.5 - 1.0)	5.9 - 8.9 x 10^{17} (± 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^{16}	≤ 2.0 x 10^{16}	≤ 2.0 x 10^{16}	≤ 2.5 x 10^{16}	≤ 2.5 x 10^{16}

Polished Wafers / Substrates			300mm			200mm			150mm			125mm	100mm
Surface Metals	Cu / Cr / Fe / Ni	at cm^{-2}	≤ 1.0 x 10^{10}			≤ 2.5 x 10^{10}			≤ 5.0 x 10^{10}			≤ 5.0 x 10^{10}	≤ 5.0 x 10^{10}
	Al / Zn / K / Na / Ca	at cm^{-2}	≤ 5.0 x 10^{10}			≤ 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	< 200-10^3	< 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	< 5.0
GFLR = TIR (Std | *UltraFlat*) *)		µm	NA			< 2.0			< 2.0		*< 1.2*	< 2.0	< 2.0
Local Flatness *) (Std | *UltraFlat*)	SFQR / STIRmax, s.b.f.	µm	< 0.25			< 0.25			< 0.5		*< 0.3*	NA	NA
	SFQD / SFPD, s.b.f.	µm	< 0.18			< 0.18			< 0.3		*< 0.2*	NA	NA
	SBIR / STIRmax, b.r.	µm	NA			< 0.7			< 1.0		*< 0.6*	< 1.0	< 1.0
Standard Site Size		mm²	25 x 25			25 x 25			15 x 15			15 x 15	15 x 15