

Technical Note on UltraThin® Silicon Wafers (<200um thick) and UltraThin® SOI Wafers

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A General Overview

Virginia Semiconductor Inc. has been producing UltraThin® [1] silicon substrates since 1988 (<200um thick). After many years of development, VSI offers Double Side Polished silicon wafers as thin as 8-10um and Single Side Polished wafers as thin as 90um. These extremely thin wafers and foils have been produced for niche-market customers and R&D specialists.

UltraThin® Wafers having diameters ranging from 25.4mm to 150mm have been supplied. VSI has also supplied thermally oxidized UltraThin® Wafers with a range of oxide thickness; even the thinnest VSI silicon wafers and foils have been successfully oxidized. In 1994 VSI was awarded the Photonics Circle of Excellence Award for Ultra Thin® Wafers used in optical applications. Only 25 products each year are selected for this award. After approximately 10 years of development and production, our Ultra Thin® wafers have found use in a variety of R&D and manufacturing applications. Today the VSI thin wafer products enjoy greatly improved surface micro-roughness and total thickness variations. VSI uses proprietary chemical-mechanical polishing techniques to produce UltraThin® wafers. Substrates ranging from about 100um to 200um thick generally have the same high quality surface finish as standard silicon wafers. Also, low total thickness variations (TTV) of less than 1 um are achievable for the 100-200um thick double side polished wafers. However, extremely thin wafers approaching 10um thick, do not have the low micro-roughness and TTV of standard Double Side Polished or Haze-Free Wafers.

B Handling UltraThin® Wafers

Several manufacturers are using small quantities of these wafers in full sensor fabrication processes and commercial products (both 100mm diameter and 150mm diameter). When handling UltraThin® Wafers VSI recommends using shovel style Teflon coated tweezers or modified vacuum wands or vacuum tweezers. Although these wafers are extremely flexible, they will quickly break under the wrong forces or pinching. Also, one must be very careful handling these wafers. HEPA filters and air handling systems make handling these wafers difficult, since the wafers are foils and can easily float away. Like all foil materials, very thin silicon has an affinity to stick or bond to other materials and surfaces. These wafers will stick to smooth metal fixtures and jigs, glass and silicon wafers, and other surfaces; subsequent removal may result in breakage. Adhesion to Teflon is not as common. VSI routinely uses standard thermal oxidation glassware and processes to

create silicon dioxide layers on thin wafers. Slower than usual push and pull procedures during thermal oxidation are used and strongly recommended.

VSI recommends review of the technical article by Alfred Binder and Gerhard Kroupa, “Novel Technology for Handling Very Thin Wafers” [2]. This article and the authors have formally investigated handling and breakage [3] issues for thin silicon wafers.

C Commercially Available UltraThin ® Wafers

A general table of thickness ranges for UltraThin ® wafers as a function of surface finish and crystallographic orientation is given below.

Wafer Type	Minimum Thickness
Double Side Polished, (100)	8um-10um
Single Side Polished, (100)	100um
Double Side Polished, (110)	25um
Single Side Polished, (110)	100um
Double Side Polished, (111)	75um
Single Side Polished, (111)	100um

Producing quality UltraThin ® wafers from (110) and (111) material is generally more difficult than from the (100) product, and therefore limited to 25um and 75um respectively. Also, these extremely thin wafers cannot be as easily and reliably produced with heavily doped materials.

VSI Also produces UltraThin ® SOI (silicon-on-insulator) wafers using wafer bonding technology. Typically VSI can produce UltraThin ® SOI having device layer thicknesses ranging from 9um to several hundred microns in thickness. Also, any orientation is available for the device and handle layer.

VSI can supply UltraThin ® wafers produced by backside grinding or lapping as well. Finally, Extremely thin Ge wafers have also been commercially produced, but this technical development is less mature. 50um thick Ge wafers have been commercially produced and sold by VSI.

D References

[1] UltraThin ® is a registered trademark. VSI owns all the rights to use the UltraThin ® trademark as related to silicon wafers and chips.

[2] Alfred Binder, Gerhard Kroupa, “Novel Technology for Handling Very Thin Wafers”, Solid State Technology, October, 2003, pg 64-68, Alfred.binder@ctr.at

[3] F.A. Schraub, Solid State Technology, September 2002, pg 59-64