

# Properties of Glass as Related to Applications with Silicon

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## A. Introduction

In this paper some very general properties for silicon and several types of Corning glass are given. Many silicon wafer-users bond silicon to glass, or use glass materials in coordination with silicon. The glass data reported here has been taken from the Corning web site [1] and assumed to be accurate. Most the data on silicon can be located by reviewing a variety of textbooks, or the primary source given in reference 2.

This Tech-note is intended to assist general silicon users with a quick reference to very basic glass properties and suppliers, and the reader should carefully review the Corning web site and other references as needed and appropriate.

## B. Basic Data on Glass and Silicon

A basic listing of glass properties for Corning 7740 and 7070 glass is given below.

*Corning 7740 Glass substrates*

Diameter and Shape: 76.2mm  $\pm$  0.5mm, 100mm  $\pm$  0.5mm, 150mm  $\pm$  0.5mm

Material Type: Borosilicate Glass

Primary Flat Length: SEMI Specification

Secondary Flat Length: SEMI Specification

Secondary Flat Orientation and Location: SEMI Specification

Center Thickness: 1000um  $\pm$  25um, 500um  $\pm$  25um standard

Total Thickness Variation (5 point measurement):  $<$ 20um

Surface Polishing and Properties: Single Side or Double Side Polished

Density: 2.23 g/cm<sup>3</sup>

Youngs Modulus: 6.4e3 Kg/mm<sup>2</sup>

Poisson's ratio: 0.2

Coefficient Thermal Expansion (0-300C): 3.25 e-6 1/C

Thermal conductivity: 0.0027 sec-cm<sup>2</sup>-C

Working Point: 1252 C

Softening Point: 820 C

Annealing Point: 560 C

Dielectric Constant: 4.6 @ 1MHz

Loss Tangent: 0.4% @ 1MHz

Index of refraction: 1.474

Light Transmission: 90% at 300nm to 2700nm

### *Corning 7070 Glass Substrates*

Diameter and Shape: 76.2mm ± 0.5mm, 100mm ± 0.5mm, 150mm± 0.5mm

Material Type: Lithia Potash Borosilicate Glass

Primary Flat Length: SEMI Specification

Secondary Flat Length: SEMI Specification

Secondary Flat Orientation and Location: SEMI Specification

Center Thickness: 1000um +/- 25um, 500um +/- 25um standard

Total Thickness Variation (5 point measurement): <20um

Surface Polishing and Properties: Single Side or Double Side Polished

Density: 2.13 g/cm<sup>3</sup>

Youngs Modulus: 5.2e3 Kg/mm<sup>2</sup>

Poisson's ratio: 0.22

Coefficient Thermal Expansion: 3.2 e-6 1/C

Working Point: 1068 C

Annealing Point: 496 C

Dielectric Constant: 4.1 @ 1MHz

Loss Tangent: 0.06% @ 1MHz

Index of refraction: 1.47

A basic listing of the properties of silicon is given below. The reader should further review the VSI Technology Library ([www.virginiasemi.com](http://www.virginiasemi.com)) for extensive details regarding silicon parameters, specifications, and characteristics.

### *CZ and FZ Silicon Substrates*

The basic specifications for VSI CZ and FZ silicon wafers are given below.

Diameter and Shape: 25.4mm ± 0.3mm, 50.8mm ± 0.3mm, 76.2mm ± 0.3mm, 100mm ± 0.3mm, 150mm± 0.3mm

Material Type: Single Crystal CZ and FZ silicon

Primary Flat Length: SEMI Specification

Secondary Flat Length: SEMI Specification

Secondary Flat Orientation and Location: SEMI Specification

Center Thickness: SEMI Specification, or any thickness greater, or as thin as 10um

Total Thickness Variation (5 point measurement): SEMI Specification, or <1um

Surface Polishing and Properties: Single Side or Double Side Polished

Density: 2.33 g/cm<sup>3</sup>

Coefficient Thermal Expansion: 2.6e-6 1/C

Thermal conductivity: 1.5 W/cm-C

Melting Point: 1415 C

Annealing Point: 1250 C

Dielectric Constant: 11.9

Resistivity: .0006 to 5000 Ohm cm (engineered)

Light Transmission: Opaque in the visible

### **C. Summary**

The basic properties of glass and silicon commonly used in the semiconductor industry have been presented.

### **D. References**

[1] As of December 2003 see [www.corning.com/lightingmaterials/images/wafersheet.pdf](http://www.corning.com/lightingmaterials/images/wafersheet.pdf)

[2] R. Hull [ *Properties of Crystalline Silicon* (INSPEC, London, 1999), EMIS Data Review Series, No. 20]