

SEMI 3D21-1019

GUIDE FOR DESCRIBING GLASS-BASED MATERIAL FOR USE IN 3DS-IC PROCESS

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NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (§§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§§) the symbols are used to reference more than one section or paragraph, respectively.

NOTICE: Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

1 Purpose

1.1 With their unique properties and features, non-silicon, dielectric materials have proven to be a valuable alternative to silicon in the semiconductor and 3DS-IC packaging industry. Such non-silicon substrates used as carrier wafers, spacers, interposers, MEMS, RF devices, and lenses. However, until now, little information about the features and characteristics of such base materials was available to the industry.

1.2 The non-silicon base material can be further processed to a substrate, which may have through vias, blind vias, and other shaped openings. With vias filled, the substrate may become an interposer. Finally, such substrates may remain in the package in a permanently bonded state or may be removed at the end of the process, such as carrier wafers.

1.3 This Guide closes the gap described in § 1.1 and serves as an umbrella document for more specific specifications.

1.4 Thereby this Guide enables and describes glass as a base material or substrate of choice for the semiconductor industry.

2 Scope

2.1 This Guide is about silicate based materials in their amorphous solid form:

2.1.1 Silicate glass.

2.1.2 Quartz glass or fusion silicate, which is silicate glass in its purest form.

2.2 This Guide describes dimensional, physical, and thermal characteristics of glass as a base material for use in semiconductor applications and 3DS-IC stacks.

2.3 The glass base material may permanently remain in the package or device or it may be removed after finishing the process.

2.4 The glass base material may be processed further to a substrate with openings, such as but not limited to through vias and blind vias.

2.5 The glass substrate is in shape of a wafer (round) or a panel (square or rectangular), but can be of any geometrical shape as specified.

2.6 If present, the openings of the glass substrate may be intended to be further processed with metal fillings.

2.7 Methods of measurements suitable for determining the characteristics in the Guide are indicated.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Quartz (crystalline structure), sapphire, ceramics, resins, polymers, or other transparent materials are not subject of this Guide.

3.2 This Guide does not provide information on processing or handling of the glass base material, substrate or finished product.

3.3 Manufacturing of the base material or any openings are not subject of this Guide.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI 3D2 — Specification for Glass Carrier Wafers for 3DS-IC Applications

SEMI 3D11 — Terminology for Through Glass Via and Blind Glass Via in Glass Geometrical Metrology

SEMI 3D12 — Guide for Measuring Flatness and Shape of Low Stiffness Substrates

SEMI 3D16 — Specification for Glass Base Material for Semiconductor Packaging

SEMI M59 — Terminology for Silicon Technology

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *BV* — blind via

5.1.2 *CTE* — coefficient of thermal expansion

5.1.3 *TGV* — through glass via

5.1.4 *TTV* — total thickness variation

5.2 Definitions

5.2.1 General Definitions

NOTE 1: Many of these definitions are similar to, but slightly different from, those in SEMI M59. In many cases the definitions in SEMI M59 can be generalized to include 3DS-IC terms, but this is not being done at the present time.

5.2.1.1 *base material* — a material that is intended to become a substrate for further processing. For instance, in a chip, the base material may be silicon.

NOTE 2: The terms ‘substrate’ and ‘base material’ are often used interchangeably.

5.2.1.2 *glass* — an amorphous solid, which means it has no crystalline structure, and that exhibits a glass transition from a brittle and solid state to a viscous liquid.

5.2.1.2.1 *quartz glass* — glass consisting of only silica in amorphous form, substantially free of impurities. Also called fused silica or fused quartz.

NOTE 3: Quartz glass is an amorphous material, whereas silica in crystalline form is referred to as quartz.

5.2.1.2.2 *silicate glass* — glass based on silica, which is silicon dioxide (SiO_2). Often, other ingredients are added to silica to lower melting temperature.

5.2.1.3 *interposer* — a substrate that has been modified in such a way as to allow the routing of electrical signals, power and ground, enabling connections between multiple die and/or passive components, and which may subsequently be enclosed in a package or module.

5.2.2 Specific Definitions

NOTE 4: Terms, acronyms, and symbols associated with through glass via (TGV) and blind via (BV) technology are listed and defined in SEMI 3D11.