IEC TS 61994-4-4

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REDLINE VERSION

TECHNICAL SPECIFICATION

colour inside

Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection – Glossary –
Part 4-4: Piezoelectric materials – ~~Materials~~ Single crystal wafers for surface acoustic wave (SAW) devices

IEC TS 61994-4-4:2018-11 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 4-4: Piezoelectric materials – ~~Materials~~ Single crystal wafers for surface acoustic wave (SAW) devices

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 61944-4-4, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This third edition of IEC 61994-4-4 cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the new terms and definitions given in IEC 62276:2016 have been taken into account;

b) the general title has been changed according to the change in the title of TC 49 in 2009.

c) the part title has been changed according to the title of IEC 62276:2016.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
49/1283/DTS	49/1287/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61994 series, published under the general title *Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection – Glossary*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION – GLOSSARY –

Part 4-4: Piezoelectric materials – Materials Single crystal wafers for surface acoustic wave (SAW) devices

1 Scope

This part of IEC 61994 specifies gives the terms and definition for single crystal wafers applied for surface acoustic wave (SAW) devices representing the state of the art, which are intended for use in the standards and documents of IEC technical committee 49.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
acceptable quality level
AQL
AQL is the maximum percent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspections, can be considered satisfactory as a process average

[IEC 60410:1973, 4.2]

3.1 Single crystals for SAW wafer

3.1.1
as-grown synthetic quartz crystal
right-handed or left-handed single crystal quartz grown hydrothermally. "As-grown" refers to the state of processing and indicates a state prior to mechanical fabrication

[SOURCE: IEC 61994-4-1:2007, 3.4 IEC 62276:2016, 3.1.1, modified – Notes 1 and 2 to entry have been removed.]

3.1.2
lanthanum gallium silicate
LGS
single crystals described by the chemical formula to $La_3Ga_5SiO_{14}$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:~~2005~~ 2016, 3.1.5]

3.1.3
lithium niobate
LN
single crystals approximately described by chemical formula $LiNbO_3$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:~~2005~~ 2016, 3.1.2]

3.1.4
lithium tantalate
LT
single crystals approximately described by chemical formula $LiTaO_3$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:~~2005~~ 2016, 3.1.3]

3.1.5
lithium tetraborate
LBO
single crystals described by the chemical formula to $Li_2B_4O_7$, grown by Czochralski (crystal pulling from melt), vertical Bridgman, or other growing methods

[SOURCE: IEC 62276:~~2005~~ 2016, 3.1.4]

3.2 Terms and definitions related to LN and LT crystals

3.2.1
curie temperature
T_c
phase transition temperature between ferroelectric and paraelectric phases measured by differential thermal analysis (DTA) or dielectric measurement

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.3.1~~ 3.2.1]

3.2.2
polarization ~~(or poling)~~ process
electrical process used to establish a single domain crystal

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.3.3~~ 3.2.3]

3.2.3
reduction process
REDOX reaction to increase conductivity to reduce the harmful effects of pyroelectricity

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.3.4~~ 3.2.4]

3.2.4
reduced LN
LN treated with a reduction process~~, sometimes referred to as "black LN"~~

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.3.4.1~~ 3.2.5, modified – Note 1 to entry has been removed.]

3.2.5
reduced LT
LT treated with a reduction process~~, sometimes referred to as "black LT"~~

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.3.4.2~~ 3.2.6, modified – Note 1 to entry has been removed.]

3.2.6
single domain
ferroelectric crystal with uniform electrical polarization throughout (for LN and LT)

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.3.2~~ 3.2.2]

3.3 Terms and definitions related to all crystals

3.3.1
congruent composition
chemical composition of a single crystal in a thermodynamic equilibrium with a molten solution of the same composition during the growth process

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.4.2~~ 3.3.2]

3.3.2
lattice constant
length of~~ one~~ unit cell along a major crystallographic axis measured by X-ray using the Bond method

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.4.1~~ 3.3.1]

3.3.3
twin
~~crystallographic defect occurring in a single crystal~~

~~NOTE The twin is separated from the rest of the material by a boundary, generally aligned along a crystal plane. The lattices on either side of the boundary are crystallographic mirror images of one another.~~

two or more same single crystals which are combined together by the law of symmetrical plane or axis

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.4.3~~ 3.3.3, modified – Notes 1 and 2 to entry have been removed.]

3.4 Flatness

3.4.1
fixed quality area
FQA
central area of a wafer surface, defined by a nominal edge exclusion, X, over which the specified values of a parameter apply

[SOURCE: IEC 62276:~~2005~~ 2016,~~ 3.7.1~~ 3.4.1, modified – Note 1 to entry has been removed.]

3.4.2
local thickness variation
LTV
variation determined by a measurement of a matrix of sites with defined edge dimensions (e.g. 5 mm × 5 mm).

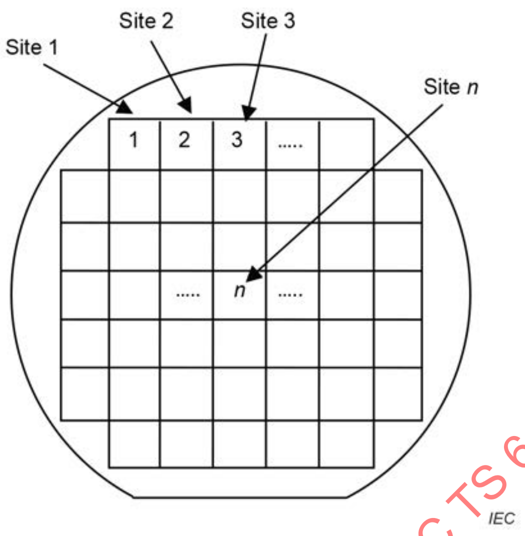

Figure 1 – Example of site distribution for LTV measurement
All sites have their centres within the FQA

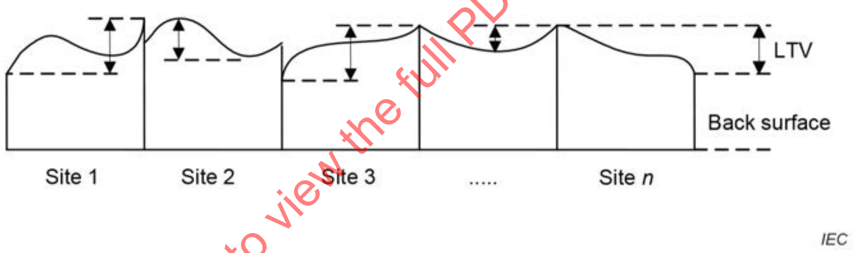

Figure 2 – LTV is a positive number and is measured at value of each site

Note 1 to entry: All sites have their centres within the FQA.

Note 2 to entry: Measurement is performed on a clamped wafer with the reference plane as defined in 3.30a 3.4.5 a). A site map example is shown in Figure 1. The value is always a positive number and is defined for each site as the difference between the highest and lowest points within each site, as shown in Figure 2. For a wafer to meet an LTV specification, all sites must shall have LTV values less than the specified value.

[SOURCE: IEC 62276:2005 2016, 3.7.8 3.4.8]

3.4.3
focal plane deviation
FPD
deviation measured relative to the 3-point reference plane

Note 1 to entry: The 3-point reference plane is defined in 3.30 b 3.4.5 b).

Note 2 to entry: The value obtained indicates the maximum distance between a point on the wafer surface (within the FQA) and the focal plane. If that point is above the reference, the FPD is positive. If that point is below the reference plane, the FPD is negative.

[SOURCE: IEC 62276:2005 2016, 3.7.10 3.4.10]

3.4.4
percent local thickness variation
PLTV
percentage of sites that fall within the specified values for LTV

Note 1 to entry: As with the LTV measurement, this is a clamped measurement.

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.9~~ 3.4.9]

3.4.5
reference plane
~~depends~~ plane depending on the flatness measurement and ~~needs to be specified. It~~ which can be any of the following:

a) for clamped measurements, the flat chuck surface that contacts the back surface of the wafer;

b) for without clamped measurements, three points at specified locations on the front surface within the FQA;

c) for without clamped measurements, the least-squares fit to the front surface using all measured points within the FQA

~~d) the least squares fit to the front surface using all measured points within one site~~

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.2~~ 3.4.2]

3.4.6
site
square area on the front surface of the wafer with one side parallel to the OF

Note 1 to entry: Flatness parameters are assessed either globally for the FQA, or for each site individually.

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.3~~ 3.4.3]

3.4.7
Sori
~~sori describes the deformation of an unclamped wafer and is defined as the~~ maximum difference between a point on the front surface and a reference plane

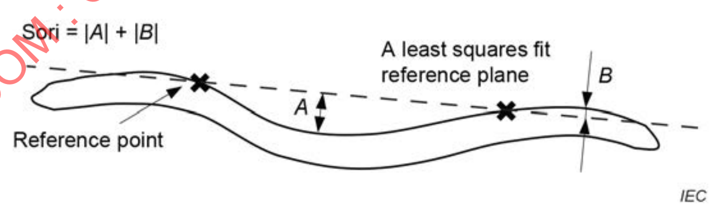

Figure 3 – Schematic diagram of Sori

Note 1 to entry: Sori describes the deformation of an unclamped wafer, as shown in Figure 3.

Note 2 to entry: In contrast to warp, in this case the reference plane is defined by a least-squares fit to the front surface (3.4.5 c)).

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.7~~ 3.4.7]

3.4.8
thickness variation for five points
TV5
measure of wafer thickness variation defined as the maximum difference between five thickness measurements

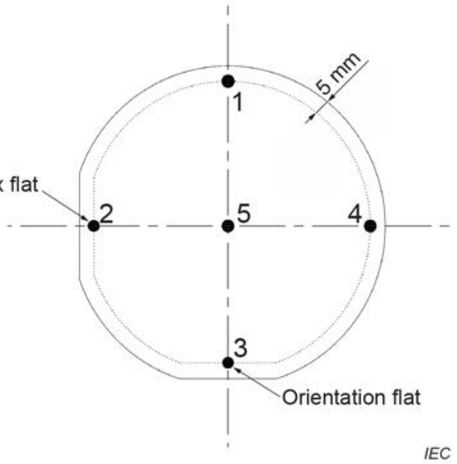

Figure 4 – Wafer ~~indication~~ sketch and measurement points for TV5 determination

Note 1 to entry: Thickness is measured at the centre of the wafer and at four peripheral points shown in Figure 4.

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.4~~ 3.4.4]

3.4.9
total thickness variation
TTV
difference between the maximum thickness ~~(*A*)~~ and the minimum thickness ~~(*B*) as shown in Figure 4.~~

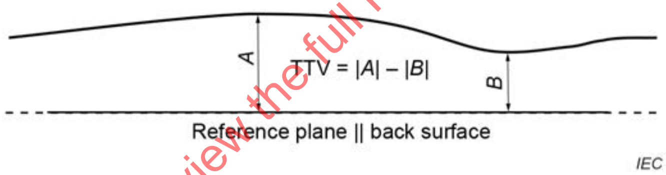

Figure 5 – Schematic diagram of TTV

Note 1 to entry: The maximum thickness is represented by the letter A and the minimum thickness is represented by the letter B in Figure 5.

Note 2 to entry: Measurement of TTV is performed under clamped conditions with the reference plane as defined in ~~3.30a)~~ 3.4.5 a).

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.7.5~~ 3.4.5]

3.4.10
warp
~~warp describes the deformation of an unclamped wafer and is defined as the~~ maximum difference between a point on the front surface and a reference plane

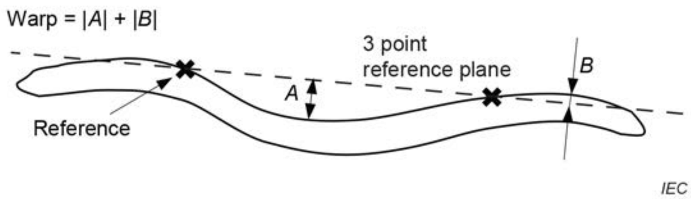

Figure 6 – Schematic diagram of warp

Note 1 to entry: Warp (shown in Figure 6) describes the deformation of an unclamped wafer.

Note 2 to entry: The reference plane is defined by 3-points as described in 3.30b 3.4.5 b). Warp is a bulk property of a wafer and not of the exposed surface alone.

[SOURCE: IEC 62276:2005 2016, 3.7.6 3.4.6]

3.5 Definitions of appearance defects

3.5.1
chip
region where material has been removed from the surface or edge of the wafer

Note 1 to entry: The size can be expressed by its maximum radial depth and peripheral chord length.

[SOURCE: IEC 62276:2005 2016, 3.16.4 3.5.4]

3.5.2
contamination
~~the first is defined as area and the second as particulate. The first is caused by surface contaminants that cannot be removed by cleaning or are stained after cleaning. Those may be foreign matter on the surface of, for example a localized area that is smudged, stained, discoloured, mottled, etc., or large areas exhibiting a hazy or cloudy appearance resulting from a film of foreign materials~~
foreign matter on a surface of wafer which cannot be removed after cleaning

[SOURCE: IEC 62276:2005 2016, 3.16.1 3.5.1]

3.5.3
crack
fracture that extends to the surface and may or may not penetrate the entire thickness of the wafer

[SOURCE: IEC 62276:2005 2016, 3.16.2 3.5.2]

3.5.4
dimple
smooth surface depression larger than 3 mm in diameter

[SOURCE: IEC 62276:2005 2016, 3.16.5 3.5.5]

3.5.5
orange peel
large featured, roughened surface visible to the unaided eye under diffuse illumination

Note 1 to entry: This is also called pear skin.

[SOURCE: IEC 62276:2005 2016, 3.16.7 3.5.7]

3.5.6
pit
non-removable surface anomaly such as a hollow, typically resulting from a bulk defect or faulty manufacturing process

[SOURCE: IEC 62276:2005 2016, 3.16.6 3.5.6, modified – The example has been included into the definition.]

3.5.7
scratch
shallow groove or cut below the established plane of the surface, with a length to width ratio greater than 5:1

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.16.3~~ 3.5.3]

3.6 Other terms and definitions

3.6.1
back surface roughness
~~definitions of R_a are given in ISO 4287~~
roughness which scatters and suppresses bulk wave spurious at back surface

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.8~~ 3.6.4]

3.6.2
bevel
slope or rounding of the wafer perimeter

Note 1 to entry: Bevel is also referred to as “edge profile”.

Note 2 to entry: The process of creating a bevel is called “bevelling” or “edge rounding”.

Note 3 to entry: The profile and its tolerances should be specified by the supplier.

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.13~~ 3.6.9]

3.6.3
description of orientation and SAW propagation
indication of the surface orientation and the SAW propagation direction, separated by the symbol “-“

Note 1 to entry: Specification of a 0° orientation is normally omitted.

Note 2 to entry: Typical examples for these expressions are shown in Table 1.

Note 3 to entry: Description of wafer orientation rule is shown in Annex A of IEC 62276:2016.

Table 1 – Description of wafer orientations

Material ~~LT~~ ~~Quartz~~	LN	LT	Quartz crystal	LBO	LGS
Expression	128° Y-X Y-Z 64° Y-X	X-112° Y 36° Y-X	ST-X	45° X-Z	yxlt/48,5°/26,6°

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.10~~ 3.6.6]

3.6.4
diameter of wafer
diameter of circular portion of wafer excluding the OF and SF regions

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.14~~ 3.6.10]

3.6.5
manufacturing lot
lot established by agreement between the customer and the supplier

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.2~~ 3.6.1]

3.6.6
orientation flat
OF
flat portion of wafer perimeter indicating the crystal orientation~~. Generally, the orientation flat corresponds to the SAW propagation direction. It is also referred to as the "primary flat" (see Figure 3)~~

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.5~~ 3.6.2, modified – Notes 1 and 2 to entry have been removed.]

3.6.7
secondary flat
SF
flat portion of wafer perimeter shorter than the OF~~. When present, the SF indicates wafer polarity and can serve to distinguish different wafer cuts. It is also referred to as the "sub-orientation flat" (see Figure 3)~~

[SOURCE: IEC 62276:~~2005~~ 2016, 3.6.3, modified – Notes 1 and 2 to entry have been removed.]

3.6.8
ST-cut
~~although the original definition is 42,75 º rotated Y-cut and X-propagation, the actual cut angle can range from 20 º to 42,75 º in order to achieve a zero temperature coefficient~~
cut direction of quartz to achieve zero temperature coefficient of frequency

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.11~~ 3.6.7, modified – The words "of frequency" have been added at the end of the definition.]

3.6.9
surface orientation
crystallographic~~al~~ orientation of the axis perpendicular to the polished surface of wafer

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.9~~ 3.6.5]

3.6.10
tolerance of surface orientation
acceptable difference between specified surface orientation and measured orientation, measured by X-ray diffraction

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.12~~ 3.6.8]

3.6.11
wafer thickness
thickness measured at the centre of the wafer

[SOURCE: IEC 62276:~~2005~~ 2016, ~~3.15~~ 3.6.11]

Bibliography

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~~Amendment 1 (1995)~~
~~Amendment 2 (1997)~~

~~IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*~~

~~IEC 61994-4-1:2007, *Piezoelectric and dielectric devices for frequency control and selection – Glossary – Part 4-1: Piezoelectric materials – Synthetic quartz crystal*~~

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 61944-4-4, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This third edition of IEC 61994-4-4 cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the new terms and definitions given in IEC 62276:2016 have been taken into account;
b) the general title has been changed according to the change in the title of TC 49 in 2009.
c) the part title has been changed according to the title of IEC 62276:2016.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
49/1283/DTS	49/1287/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61994 series, published under the general title *Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection – Glossary*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION – GLOSSARY –

Part 4-4: Piezoelectric materials – Single crystal wafers for surface acoustic wave (SAW) devices

1 Scope

This part of IEC 61994 gives the terms and definition for single crystal wafers for surface acoustic wave (SAW) devices representing the state of the art.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Single crystals for SAW wafer

3.1.1
as-grown synthetic quartz crystal
right-handed or left-handed single crystal quartz grown hydrothermally

[SOURCE: IEC 62276:2016, 3.1.1, modified – Notes 1 and 2 to entry have been removed.]

3.1.2
lanthanum gallium silicate
LGS
single crystals described by the chemical formula to $La_3Ga_5SiO_{14}$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:2016, 3.1.5]

3.1.3
lithium niobate
LN
single crystals approximately described by chemical formula $LiNbO_3$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:2016, 3.1.2]

3.1.4
lithium tantalate
LT
single crystals approximately described by chemical formula $LiTaO_3$, grown by Czochralski (crystal pulling from melt) or other growing methods

[SOURCE: IEC 62276:2016, 3.1.3]

3.1.5
lithium tetraborate
LBO
single crystals described by the chemical formula to $Li_2B_4O_7$, grown by Czochralski (crystal pulling from melt), vertical Bridgman, or other growing methods

[SOURCE: IEC 62276:2016, 3.1.4]

3.2 Terms and definitions related to LN and LT crystals

3.2.1
curie temperature
T_c
phase transition temperature between ferroelectric and paraelectric phases measured by differential thermal analysis (DTA) or dielectric measurement

[SOURCE: IEC 62276:2016, 3.2.1]

3.2.2
polarization process
electrical process used to establish a single domain crystal

[SOURCE: IEC 62276:2016, 3.2.3]

3.2.3
reduction process
REDOX reaction to increase conductivity to reduce the harmful effects of pyroelectricity

[SOURCE: IEC 62276:2016, 3.2.4]

3.2.4
reduced LN
LN treated with a reduction process

[SOURCE: IEC 62276:2016, 3.2.5, modified – Note 1 to entry has been removed.]

3.2.5
reduced LT
LT treated with a reduction process

[SOURCE: IEC 62276:2016, 3.2.6, modified – Note 1 to entry has been removed.]

3.2.6
single domain
ferroelectric crystal with uniform electrical polarization throughout (for LN and LT)

[SOURCE: IEC 62276:2016, 3.2.2]

3.3 Terms and definitions related to all crystals

3.3.1
congruent composition
chemical composition of a single crystal in a thermodynamic equilibrium with a molten solution of the same composition during the growth process

[SOURCE: IEC 62276:2016, 3.3.2]

3.3.2
lattice constant
length of unit cell along a major crystallographic axis measured by X-ray using the Bond method

[SOURCE: IEC 62276:2016, 3.3.1]

3.3.3
twin
two or more same single crystals which are combined together by the law of symmetrical plane or axis

[SOURCE: IEC 62276:2016, 3.3.3, modified – Notes 1 and 2 to entry have been removed.]

3.4 Flatness

3.4.1
fixed quality area
FQA
central area of a wafer surface, defined by a nominal edge exclusion, X, over which the specified values of a parameter apply

[SOURCE: IEC 62276:2016, 3.4.1, modified – Note 1 to entry has been removed.]

3.4.2
local thickness variation
LTV
variation determined by a measurement of a matrix of sites with defined edge dimensions

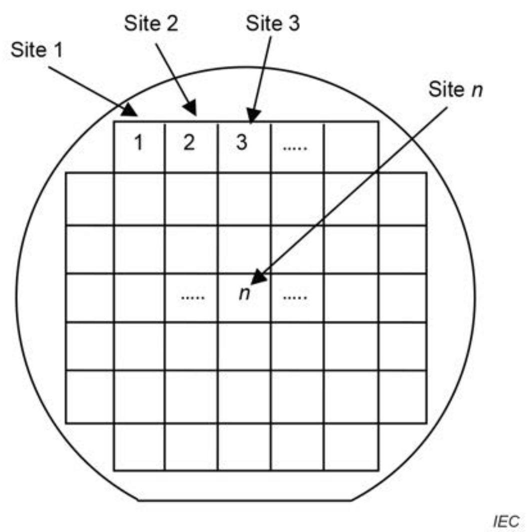

Figure 1 – Example of site distribution for LTV measurement

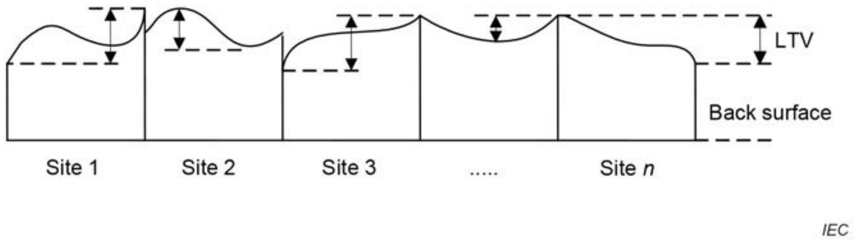

Figure 2 – LTV value of each site

Note 1 to entry: All sites have their centres within the FQA.

Note 2 to entry: Measurement is performed on a clamped wafer with the reference plane as defined in 3.4.5 a). A site map example is shown in Figure 1. The value is always a positive number and is defined for each site as the difference between the highest and lowest points within each site, as shown in Figure 2. For a wafer to meet an LTV specification, all sites shall have LTV values less than the specified value.

[SOURCE: IEC 62276:2016, 3.4.8]

3.4.3
focal plane deviation
FPD
deviation measured relative to the 3-point reference plane

Note 1 to entry: The 3-point reference plane is defined in 3.4.5 b).

Note 2 to entry: The value obtained indicates the maximum distance between a point on the wafer surface (within the FQA) and the focal plane. If that point is above the reference, the FPD is positive. If that point is below the reference plane, the FPD is negative.

[SOURCE: IEC 62276:2016, 3.4.10]

3.4.4
percent local thickness variation
PLTV
percentage of sites that fall within the specified values for LTV

Note 1 to entry: As with the LTV measurement, this is a clamped measurement.

[SOURCE: IEC 62276:2016, 3.4.9]

3.4.5
reference plane
plane depending on the flatness measurement and which can be any of the following:

a) for clamped measurements, the flat chuck surface that contacts the back surface of the wafer;

b) for without clamped measurements, three points at specified locations on the front surface within the FQA;

c) for without clamped measurements, the least-squares fit to the front surface using all measured points within the FQA

[SOURCE: IEC 62276:2016, 3.4.2]

3.4.6
site
square area on the front surface of the wafer with one side parallel to the OF

Note 1 to entry: Flatness parameters are assessed either globally for the FQA, or for each site individually.

[SOURCE: IEC 62276:2016, 3.4.3]

3.4.7
Sori
maximum difference between a point on the front surface and a reference plane

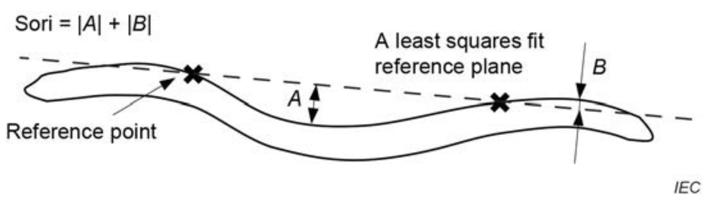

Figure 3 – Schematic diagram of Sori

Note 1 to entry: Sori describes the deformation of an unclamped wafer, as shown in Figure 3.

Note 2 to entry: In contrast to warp, in this case the reference plane is defined by a least-squares fit to the front surface (3.4.5 c)).

[SOURCE: IEC 62276:2016, 3.4.7]

3.4.8
thickness variation for five points
TV5
measure of wafer thickness variation defined as the maximum difference between five thickness measurements

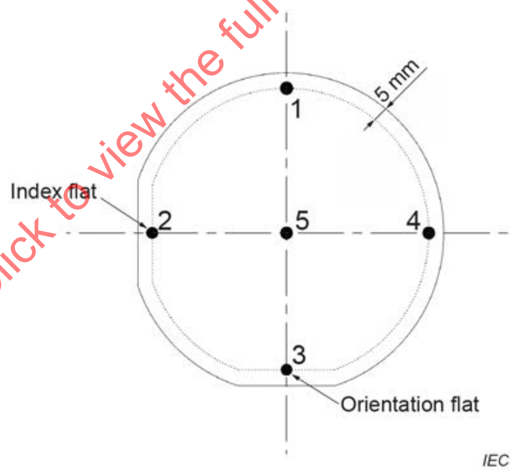

Figure 4 – Wafer sketch and measurement points for TV5 determination

Note 1 to entry: Thickness is measured at the centre of the wafer and at four peripheral points shown in Figure 4.

[SOURCE: IEC 62276:2016, 3.4.4]

3.4.9
total thickness variation
TTV
difference between the maximum thickness and the minimum thickness