



SLOVENSKI STANDARD
oSIST prEN IEC 62276:2023

01-oktober-2023

Enokristalne rezine za površinske zvočnovalovne naprave (SAW) - Specifikacije in merilne metode

Single crystal wafers for surface acoustic wave (SAW) device applications - Specifications and measuring methods

Einkristall-Wafer für Oberflächenwellen-(OFW-)Bauelemente - Festlegungen und Messverfahren

Tranches monocristallines pour applications utilisant des dispositifs à ondes acoustiques de surface (OAS) - Spécifications et méthodes de mesure

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TITLE:

Single crystal wafers for surface acoustic wave (SAW) device applications - Specifications and measuring methods

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**SINGLE CRYSTAL WAFERS FOR SURFACE ACOUSTIC WAVE (SAW)
DEVICE APPLICATIONS – SPECIFICATIONS AND MEASURING METHODS**

159

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161

162

FOREWORD

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194 IEC 62276 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and
195 electrostatic devices and associated materials for frequency control, selection and detection. It
196 is an International Standard.

197 This fourth edition cancels and replaces the third edition published in 2016. This edition
198 constitutes a technical revision.

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

201 a) The terms and definitions, the technical requirements, sampling frequency, test methods
202 and measurement of transmittance, lightness, colour difference for LN and LT are added in
203 order to meet the needs of industry development;

204 b) The terms and definitions of inclusion mentioned in Clause 5.4 and 6.9 is added because
205 they are for lack of definition in Clause 3;

206 c) The specification of LTV and PLTV, and the corresponding description of sampling
207 frequency for LN and LT are added, because they are the key performance parameters for
208 the wafers;

209 d) The tolerance of Curie temperature specification for LN and LT are added in order to meet
210 the development requirements of the industry;

- 211 e) Measurement of thickness, TV5, TTV, LTV and PLTV are completed, including measurement
 212 principle and method of thickness, TV5, TTV, LTV and PLTV ;
- 213 f) The format of bibliography has been improved in accordance with the latest edition of ISO
 214 690.

215 The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

216 Full information on the voting for its approval can be found in the report on voting indicated in
 217 the above table.
 218

219 The language used for the development of this International Standard is English.

220 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
 221 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
 222 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
 223 described in greater detail at www.iec.ch/publications.

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

- 227 • reconfirmed,
- 228 • withdrawn,
- 229 • replaced by a revised edition, or
- 230 • amended.

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231

INTRODUCTION

232 A variety of piezoelectric materials are used for surface acoustic wave (SAW) filter and
233 resonator applications. Prior to an IEC meeting in 1996 in Rotterdam, wafer specifications were
234 typically negotiated between users and suppliers. During this meeting, a proposal was
235 announced to address wafer standardization. This standard has been prepared in order to
236 provide industry standard technical specifications for manufacturing piezoelectric single crystal
237 wafers to be used in surface acoustic wave devices.

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238 **SINGLE CRYSTAL WAFERS FOR SURFACE ACOUSTIC WAVE (SAW)**
239 **DEVICE APPLICATIONS – SPECIFICATIONS AND MEASURING METHODS**
240
241

242 **1 Scope**

243 This document applies to the manufacture of synthetic quartz, lithium niobate (LN), lithium
244 tantalate (LT), lithium tetraborate (LBO), and lanthanum gallium silicate (LGS) single crystal
245 wafers intended for use as substrates in the manufacture of surface acoustic wave (SAW) filters
246 and resonators.

247 **2 Normative references**

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

252 IEC 60758:2016, Synthetic quartz crystal – Specifications and guidelines for use

253 ISO 2859-1:1999, Sampling procedures for inspection by attributes – Part 1: Sampling schemes
254 indexed by acceptance quality limit (AQL) for lot-by-lot inspection

255 **3 Terms and definitions**

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

257 ISO and IEC maintain terminology databases for use in standardization at the following
258 addresses:

- 259 • IEC Electropedia: available at <https://www.electropedia.org/>
- 260 • ISO Online browsing platform: available at <https://www.iso.org/obp>

261 **3.1 Single crystals for SAW wafer**

262 **3.1.1**

263 **as-grown synthetic quartz crystal**

264 synthetic quartz crystal prior to grinding or cutting

265 **3.1.2**

266 **lithium niobate**

267 **LN**

268 single crystal approximately described by the chemical formula LiNbO_3 , grown by the
269 Czochralski (crystal pulling from melt) or other methods

270 **3.1.3**

271 **lithium tantalate**

272 **LT**

273 single crystal approximately described by the chemical formula LiTaO_3 , grown by the Czochralski
274 (crystal pulling from melt) or other methods

275 **3.1.4**

276 **lithium tetraborate**

277 **LBO**

278 single crystal described by the chemical formula $\text{Li}_2\text{B}_4\text{O}_7$, grown by the Czochralski (crystal
279 pulling from melt), the vertical Bridgman, or other methods

280 **3.1.5**

281 **lanthanum gallium silicate**

282 **LGS**

283 single crystal described by the chemical formula $\text{La}_3\text{Ga}_5\text{SiO}_{14}$, grown by the Czochralski (crystal
284 pulling from melt) or other methods

285 **3.2 Terms and definitions related to LN and LT crystals**

286 **3.2.1**

287 **Curie temperature**

288 T_c

289 phase transition temperature between ferroelectric and paraelectric phases measured by
290 differential thermal analysis (DTA) or dielectric measurement

291 **3.2.2**

292 **single domain**

293 ferroelectric crystal with uniform electric polarization throughout

294 **3.2.3**

295 **polarization process**

296 electrical process used to establish a single domain crystal

297 **3.2.4**

298 **reduction process**

299 process comprising a reduction-oxidation (REDOX) reaction to increase conductivity to reduce
300 the harmful effects of pyroelectricity

301 **3.2.5**

302 **reduced LN**

303 LN treated with a reduction process

304 Note 1 to entry: Reduced LN is sometimes referred to as "black LN".

305 **3.2.6**

306 **reduced LT**

307 LT treated with a reduction process

308 Note 1 to entry: Reduced LT is sometimes referred to as "black LT".

309 **3.2.7**

310 **transmittance**

311 τ

312 the ratio of transmitted power through the sample to incident power on the sample, expressed in
313 percent

314 **3.2.8**

315 **lightness**

316 L^*

317 the relative light-dark properties of the object surface

318 Note 1 to entry: In the CIE LAB colour space, L^* is the coordinates representing the lightness of the colour of the
319 object.

320 **3.2.9**

321 **colour difference**

322 ΔE_{ab}^*

323 the difference in colour at different parts of the object surface

324 Note 1 to entry: In the CIE LAB colour space, ΔE_{ab}^* is the value representing the colour difference of different parts
325 of the object surface.

326 **3.3 Terms and definitions related to all crystals**

327 **3.3.1**

328 **lattice parameter**

329 **lattice constant**

330 length of one unit cell along the major crystallographic axis

331 Note 1 to entry: The lattice parameter is measured by X-ray diffraction using the Bond method.

332 **3.3.2**

333 **congruent composition**

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

336 **3.3.3**

337 **twin**

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

340 Note 1 to entry: Twins exhibit symmetry that may be classified as reflection across a mirror plane (twin plane), rotation
341 around an axis (twin axis), or inversion through a point (twin center).

342 Note 2 to entry: Optical twins (growth twins) and electrical twins (transformation twins) are the most relevant to SAW
343 wafers. Optical twins arise from defects related to growth. Electrical twins may result from extreme conditions
344 (temperature and pressure, for example) during processing.

345 3.4 Flatness

346 3.4.1 347 fixed quality area 348 FQA

349 central area of a wafer surface, defined by a nominal edge exclusion, X, over which the
350 specified values of a parameter apply

351 Note 1 to entry: The boundary of the FQA is at all points (e.g. along wafer flats) the distance X away from the
352 perimeter of the wafer of nominal dimensions as shown in Figure 1.

353 3.4.2 354 reference plane

355 plane used as a reference for flatness measurements

356 Note 1 to entry: The reference plane can be one of the following types:

357 a) for measurements in which the wafer is clamped, the reference plane is the flat chuck surface that is identical with
358 the back surface of the wafer;

359 b) for measurements in which the wafer is not clamped, the reference plane is defined by the surface height at three
360 points on the front surface of the wafer within the FQA;

361 c) for measurements in which the wafer is not clamped, the reference plane is defined by the least-squares fit to the
362 front surface of the wafer using the surface height at all measured points within the FQA.

363 3.4.3 364 site

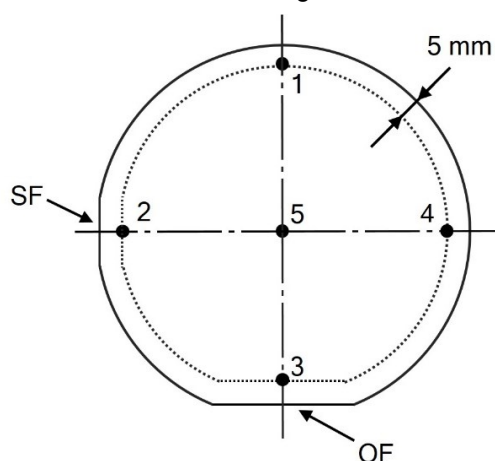
365 square area on the front surface of the wafer with one side parallel to the OF

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

367 3.4.4 [https://standards.iteh.ai/catalog/standards/sist/7da4c334-2d59-44ab-8f8d- 368 bb8a/osist-pren-iec-62276-2023](https://standards.iteh.ai/catalog/standards/sist/7da4c334-2d59-44ab-8f8d-bb8a/osist-pren-iec-62276-2023) 369 thickness variation for five points

370 TV5

371 difference between the maximum thickness and the minimum thickness at the centre and
372 four peripheral points of the wafer as shown in Figure 1



372

373

Figure 1 – Wafer sketch and measurement points

374 3.4.5 375 total thickness variation 376 TTV

377 difference between the maximum thickness d_1 and the minimum thickness d_2 of a wafer as
378 shown in Figure 2

379