PIEZOCRYST



$GaPO_4$

Material Constants

GENERAL DATA

Point group:	32 (D_3) (quartz-homeotype)
Lattice constants (25°C)	a = 4.901 Å, c = 11.048 Å
Density (25°C)	3570 kg/m^3

PIEZOELECTRIC CONSTANTS

	25°C	500°C	700°C	950°C
d_{11}[a,b] [pC/N]	4.5	4.5	4.5	4.1[c]
d_{14}[a] [pC/N]	1.9	1.6	1.4[c]	1.0[c]

PIEZOELECTRIC TENSOR

$$\begin{pmatrix} d_{11} & -d_{11} & 0 & d_{14} & 0 & 0 \\ 0 & 0 & 0 & 0 & -d_{14} & -2d_{11} \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

THERMAL EXPANSION COEFFICIENTS (25°C)

	10^{-6} K^{-1}	10^{-9} K^{-2}	10^{-12} K^{-3}	10^{-15} K^{-4}
α_{11}	12.78	10.6	-16.1	12.3
α_{33}	3.69	5.0	-5.4	3.6

THERMAL CONDUCTIVITY

	50°C	70°C	100°C	130°C	150°C	180°C	200°C
λ_{11} [W $m^{-1}K^{-1}$]	4.21	3.96	3.68	3.28	3.07	2.85	2.71
λ_{33} [W $m^{-1}K^{-1}$]	6.66	6.14	5.66	5.00	4.78	4.27	4.02

ELECTRIC RESISTIVITY

	25°C	200°C	300°C	500°C	700°C	900°C
ρ [Ωm]	> 10^{15}	> 10^{13}	> 10^{11}	> 10^{9}	> 10^{7}	> 10^{5}

ELASTIC CONSTANTS (25°C)

	GPa	10^{-6} K^{-1}	10^{-9} K^{-2}	10^{-12} K^{-3}
c_{11}^{E}	66.58	- 44.1	- 28.5	- 59.4
c_{12}^{E}	21.81	- 226.7	- 70.8	- 205.7
c_{13}^{E}	24.87	- 57.6	41.3	- 109.9
$c_{14}^{E\,b}$	3.91	507.2	280.6	- 99.9
c_{33}^{E}	102.13	- 127.5	- 18.3	- 134.8
c_{44}^{E}	37.66	- 0.4	- 43.8	- 37.1
c_{66}^{E}	22.38	44.9	- 7.9	11.9

	10^{12} m^2 N^{-1}	10^{-6} K^{-1}	10^{-9} K^{-2}	10^{-12} K^{-3}
s_{11}^{E}	17.93	22.4	30.5	62.4
s_{12}^{E}	- 4.82	- 210.5	- 0.1	- 271.3
s_{13}^{E}	- 3.19	181.6	78.2	322.2
$s_{14}^{E\,b}$	- 2.36	482.2	315.5	7.9
s_{33}^{E}	11.35	147.9	14.1	261.5
s_{44}^{E}	27.04	18.7	54.7	52.0
s_{66}^{E}	45.51	- 26.9	24.0	- 8.3

RELATIVE DIELECTRIC CONSTANTS (1 kHz, 25°C)

ε_{11}^{T}	6.1	ε_{11}^{S}	5.8
ε_{33}^{T}	6.6	ε_{33}^{S}	6.6

[a] sign according to standard IEEE 176-1987 for right-handed crystal; for left-handed $GaPO_4$ crystals, the signs of d_{11}, and d_{14} are changed

[b] IEC 758 1993-04 signs are changed

[c] predicted value