Piezoelectric PMN-PT Single Crystal Products

Sense

Move

CTS Your Partner in Smart Solutions

The Largest and Only Fully Integrated Piezoelectric Single Crystal Provider

CTS is the leading developer and manufacturer of high-performance piezoelectric single crystals; specializing in lead magnesium niobate-lead titanate (PMN-PT) based materials.

Currently the largest volume manufacturer of PMN-PT based piezoelectric single crystal products, CTS' materials are employed by leading original equipment manufacturers (OEMs) for use in acoustic transduction devices such as actuators, sensors, ultrasonic imaging transducers and active vibration controls. In addition, we manufacture bulk acoustic wave devices for telecommunications, medical and defense applications.

PMN-PT and PIN-PMN-PT Single Crystals Enable:

- Higher resolution medical ultrasound transducers due to higher bandwidth
- Actuators with displacements up to three times that of PZT actuators
- Reduced transducer size due to higher energy density
- Sensors with improved detection limits
- Unique vibration modes which are not available with PZT ceramics

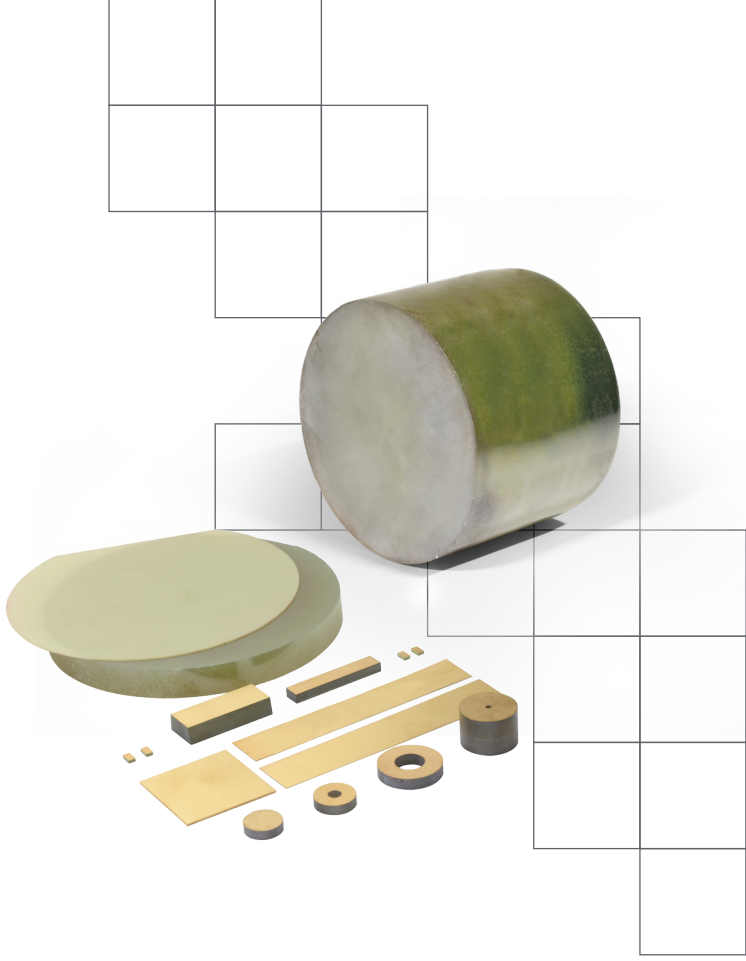
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The Single Crystal Leader

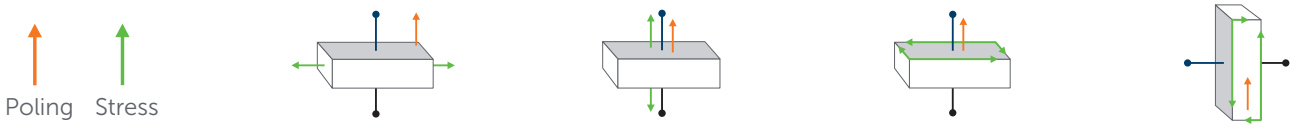
CTS Corporation is the largest, fully integrated developer and manufacturer of piezoelectric single crystals.

Capable of high volume manufacturing of both PMN-PT and PIN-PMN-PT monolithic crystals, CTS' single crystal manufacturing facility utilizes proprietary manufacturing processes and intellectual property for large-scale production of single crystals.



In-House Production Capabilities Include:

- Crystal growth
- Platinum crucible manufacturing (platinum refining and crucible refurbishment)
- Chemical batch purification
- Crystal orientation
- Machining (slicing, grinding, lapping and polishing)
- Plasma magnetron sputtering for coating electrode
- Reactive ionized etching (RIE)
- IEEE standard electrical tests for quality control



	TE Transverse Extension	LE Longitudinal Extension	LS Longitudinal Shear	TS Transverse Shear
<001> poling	d_{31}/d_{32} -500~-1000 pC/N	d_{33} 1200~2000 pC/N k_{33}~0.9	d_{36} 0	d_{15}/d_{24} <200 pC/N
<011> poling	d_{32} -1200~-1800 pC/N k_{32}~0.84-0.9	d_{33} ~1000 pC/N	d_{36} 2500 pC/N k_{36}~0.9	d_{15}/d_{24} 2000~3500 pC/N k_{15}~0.9
<111> poling	d_{31}/d_{32} <-150 pC/N	d_{33} <200 pC/N	d_{36} 0	d_{15}/d_{24} 4000~7000 pC/N k_{15}~0.95

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Property	Symbol	Units	Material Type			
			PMN-28% PT Type A	PMN-32% PT Type B	PIN24%-PMN-PT	PIN33%-PMN-PT
Density	r	kg/m^3	8100	8100	8122	8141
Phase Transition	Trt	ºC	90-100	80-90	100-115	115-135
Curie Temperature	Tc	ºC	120-130	130-140	140-170	160-200
Coercive Field	Ec	kV/cm	2.5	2.5	4.5-6	5.5-7
Piezoelectric Constants	d_{15}	pC/N	135	192	122	147
	d_{31}		-568	-760	-646	-651
	d_{33}		1190	1620	1285	1338
	e_{15}	C/m^2	8.69	8.69	8.52	9.48
	e_{31}		-13.12	-15.99	-9.11	-4.81
	e_{33}		21.72	19.42	17.60	19.31
	g_{15}	$x10^{-3}$ Vm/N	9.53	13.39	7.98	9.97
	g_{31}		-11.67	-12.29	-15.36	-16.23
	g_{33}		24.45	26.15	30.55	33.36
	h_{15}	$x10^8$ V/m	6.69	9.59	5.97	7.10
	h_{31}		-16.55	-25.81	-11.86	-6.00
	h_{33}		27.41	31.34	22.92	24.10
Dielectric Constants	ε^S_{11}	(ε_0)	1467	1368	1611	1509
	ε^S_{33}		895	700	868	905
	ε^T_{11}		1600	1620	1728	1666
	ε^T_{33}		5500	7000	4753	4532
	$ß^S_{11}$	$x10^{-4}/(\varepsilon_0)$	6.82	7.31	6.21	6.63
	$ß^S_{33}$		11.17	14.29	11.52	11.05
	$ß^T_{11}$		6.25	6.17	5.79	6.00
	$ß^T_{33}$		1.82	1.43	2.10	2.21
Electromechanical Coupling Constants	k_{15}		28%	39%	26%	31%
	k_{31}		43%	44%	46%	47%
	k_{33}		90%	93%	89%	89%
	k_t		60%	62%	50%	54%
Elastic Stiffness Constants	C^E_{11}	10^{10} N/m²	11.58	11.21	12.43	11.57
	C^E_{12}		10.23	10.16	10.90	10.03
	C^E_{13}		9.31	9.04	11.02	10.15
	C^E_{33}		10.71	9.68	12.45	11.32
	C^E_{44}		6.44	6.05	6.98	6.45
	C^E_{66}		6.01	5.51	6.21	5.44
	C^D_{11}		13.75	15.34	13.51	11.86
	C^D_{12}		12.40	14.29	11.98	10.32
	C^D_{13}		5.71	4.03	8.93	8.99
	C^D_{33}		16.66	15.77	16.49	15.97
	C^D_{44}		7.02	7.16	7.49	7.12
	C^D_{66}		6.01	5.51	6.21	5.44
Elastic Compliance Constants	S^E_{11}	10^{-12} m²/N	45.86	58.85	45.76	47.18
	S^E_{12}		-28.11	-36.58	-19.60	-17.75
	S^E_{13}		-15.43	-20.80	-23.16	-26.39
	S^E_{33}		36.15	49.18	49.04	56.15
	S^E_{44}		15.53	16.53	14.33	15.50
	S^E_{66}		16.64	18.15	16.10	18.38
	S^D_{11}		39.23	49.53	35.84	36.62
	S^D_{12}		-34.73	-45.90	-29.52	-28.32
	S^D_{13}		-1.54	-0.93	-3.43	-4.67
	S^D_{33}		7.06	6.82	9.78	11.52
	S^D_{44}		14.24	13.96	13.35	14.04
	S^D_{66}		16.64	18.15	16.10	18.38

All properties listed are for <001> poling.

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2016.12 - NCH