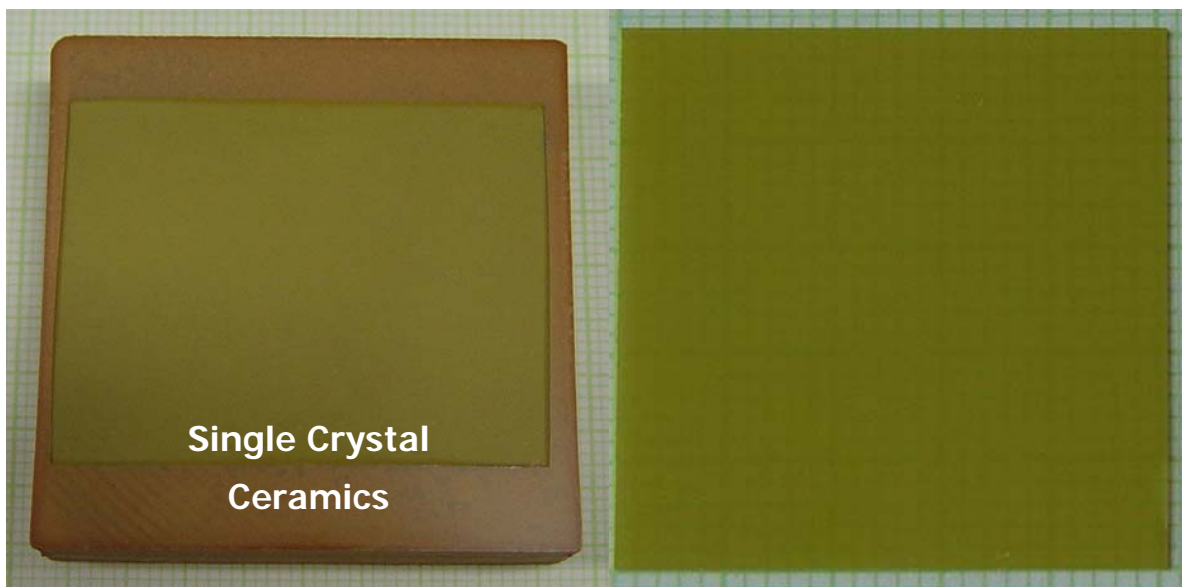


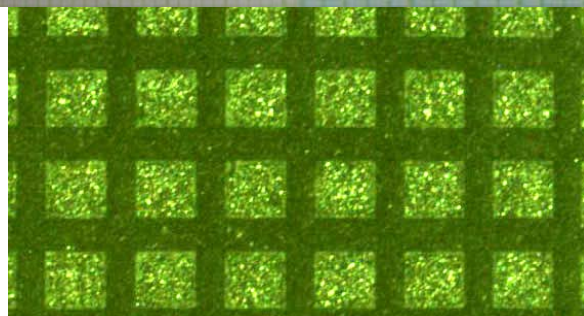
# **Piezoelectric Single Crystals (PMN-PT and PMN-PZT)**

**Cost-Effective  
Solid-State Crystal Growth**

**High Quality  
Single Crystal Wafer**



**Single Crystal  
Ceramics**



**High Performance  
Single Crystal-Epoxy Composite**

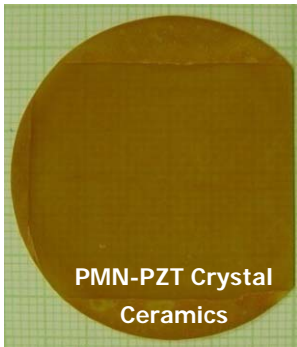
**Ceracomp Co., Ltd.**

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**Piezoelectric Single Crystals, Crystal-Epoxy Composites, and Their Application**

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Contact: sales@ceracomp.com (www.ceracomp.com), Tel: 041-584-2366, Fax: 041-584-2367

## 1. Solid-State Crystal Growth (SSCG) Method for PMN-PT and PMN-PZT

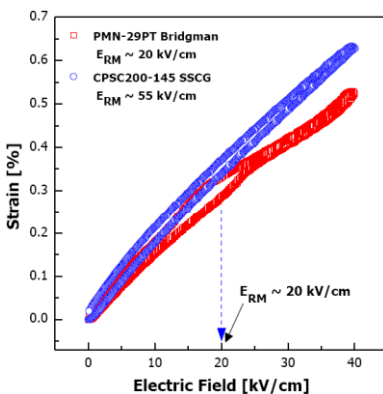


Ceracomp Co. Ltd. announces the release of piezoelectric PMN-PT and PMN-PZT single crystals, which are fabricated by the cost-effective solid-state crystal growth (SSCG) method. Their excellent dielectric and piezoelectric properties make them the best candidates for transducers, actuators, and single crystal-polymer composites.

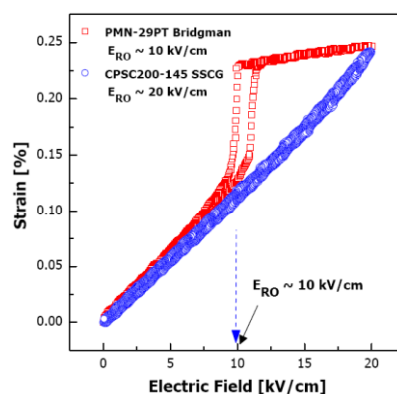
PMN-PT and PMN-PZT single crystals ( $\langle 001 \rangle$  &  $\langle 011 \rangle$ ) are available with lateral dimensions up to 40 mm. High  $T_C$  PMN-PZT single crystals ( $T_C > 200^\circ\text{C}$ ) are also available by request.

## 2. Typical Properties of (001) PMN-29PT and PMN-PZT (CPSC[ $T_C$ ]-[ $T_{RT}$ ])

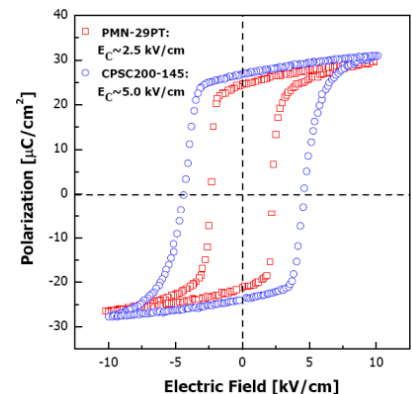
	PMN-29PT	CPSC 160-95	CPSC 180-120	CPSC 200-145	HPSC 180-120	HPSC 200-145
Dielectric Constant [ $\epsilon_{33}^T/\epsilon_0$ ]	5,500	7,000	6,000	4,500	4,000	3,500
Dielectric Loss [ $\tan\delta$ , %]	0.5	0.5	0.5	0.5	0.3	0.3
Curie Temperature [ $T_C$ , $^\circ\text{C}$ ]	130	160	180	200	180	200
R-T Transition Temp. [ $T_{RT}$ , $^\circ\text{C}$ ]	90	95	120	145	120	145
EM Coupling Factor [ $k_{33}$ ]	0.90	0.93	0.93	0.92	0.9	0.9
Piezoelectric Const. [ $d_{33}$ , pC/N]	1,500	2,000	1,850	1,500	1,300	1,100
EM Coupling Factor [ $k_{32}$ ] - (011)	0.87	0.91	0.90	0.90	0.88	0.86
Piezo. Const. [ $d_{32}$ , pC/N] - (011)	1,350	1,850	1,650	1,400	1,200	900
Coercive Electric Field [ $E_C$ , kV/cm]	2.5	4	4	5	5	6
Mechanical Quality Factor [ $Q_m$ ]	100	100	100	100	> 500	> 1,000



(a) (001) plates



(b) (011) plates



(c) (001) plates

Strains ((a) and (b)) and Polarization (c) of SSCG CPSC200-145 and Bridgman PMN-29PT under Electric Field: Linear Strain, Electric Field-Induced Phase Transitions, and Coercive Electric Field ( $E_C$ )

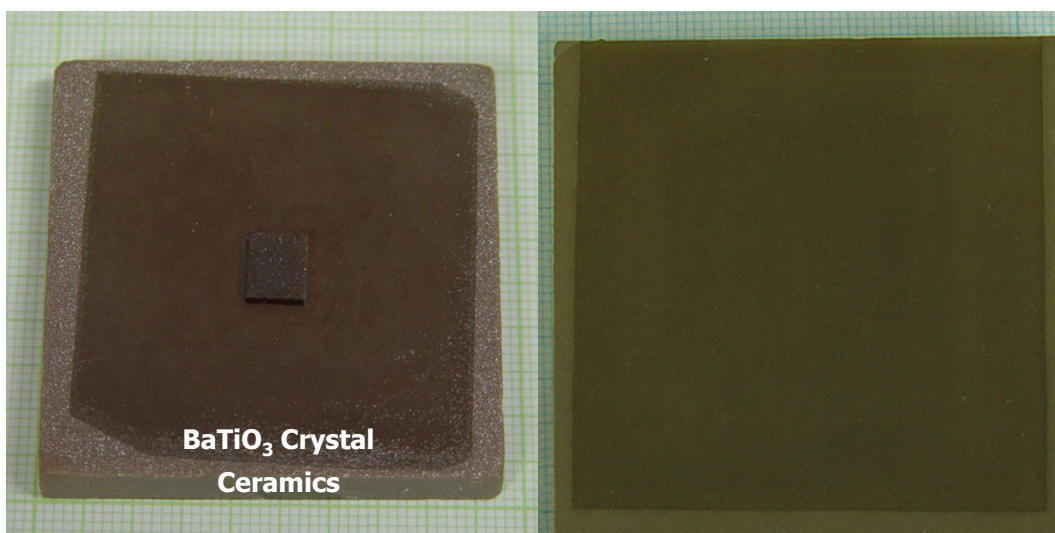
**Ceracomp Co., Ltd.**



# Ferroelectric Single Crystals ( $\text{BaTiO}_3$ , $\text{Ba}(\text{Zr},\text{Ti})\text{O}_3$ , $(\text{Ba},\text{Sr})\text{TiO}_3$ )

**Cost-Effective  
Solid-State Crystal Growth**

**Large (> 50x50 mm)  
Single Crystal Wafer**



**High Quality Single Crystal**

**Ceracomp Co., Ltd.**

**Piezoelectric Single Crystals and Superconducting Materials**

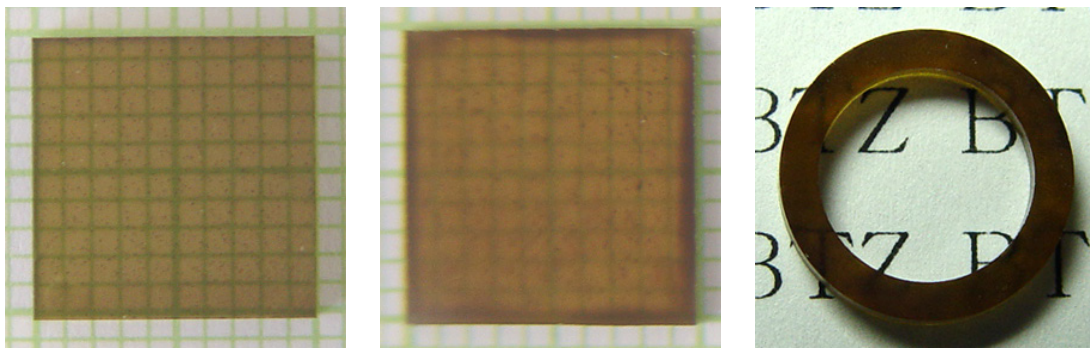
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Contact: sales@ceracomp.com (www.ceracomp.com), Tel: 041-584-2366, Fax: 041-584-2367

## 1. Solid-State Crystal Growth (SSCG) Method for BT, BZT and BST

Ceracomp Co. Ltd. announces the release of ferroelectric single crystals ( $\text{BaTiO}_3$  [BT],  $\text{Ba}(\text{Zr},\text{Ti})\text{O}_3$  [BZT] and  $(\text{Ba},\text{Sr})\text{TiO}_3$  [BST]), which are fabricated by the cost-effective solid-state crystal growth (SSCG) method. These single crystals can be used as single crystal substrates and for ferroelectric applications, because of their excellent ferroelectric, electro-optic and photorefractive properties.

BT, BZT and BST single crystals ( $\langle 001 \rangle$  &  $\langle 011 \rangle$ ) are available with lateral dimensions up to 50 mm. Doped single crystals and other ferroelectric single crystals are also available by request.

## 2. BT, BZT, and BST Single Crystals Grown by SSCG Technique



(a)  $(001) \text{BaTiO}_3$

(b)  $(001) \text{Ba}(\text{Zr}_{0.075}\text{Ti}_{0.925})\text{O}_3$

(c)  $\text{Ba}(\text{Zr}_{0.075}\text{Ti}_{0.925})\text{O}_3$  Ring

## 3. Properties of BZT Single Crystals ( $\text{Ba}(\text{Zr}_x\text{Ti}_{1-x})\text{O}_3$ ; $0 \leq x \leq 0.3$ )

Table 1. Crystal Structure and Lattice Parameter of BZT Single Crystals

	X=0.0	X=0.075	X=0.1	X=0.2	X=0.3
Crystal Structure	Tetragonal	Rhombohedral	Rhombohedral	Rhombohedral	Cubic
Lattice Parameter (Å)	4.00	4.2	4.25	4.45	4.65
$T_C$ [°C]	120	100	85	35	-45

Table 2. Dielectric and Piezoelectric Properties of  $\text{Ba}(\text{Zr}_{0.075}\text{Ti}_{0.925})\text{O}_3$  Single Crystals

$T_C$ [°C]	$T_{OT}$ [°C]	$T_{RO}$ [°C]	$\epsilon_{33}^T / \epsilon_0$	Loss [%]
100	70	40	4000	0.5
$d_{33}$ [pC/N]	$k_{33}$	$s_{33}^E$ [ $\times 10^{-12} \text{ m}^2/\text{N}$ ]	$s_{33}^D$ [ $\times 10^{-12} \text{ m}^2/\text{N}$ ]	Qm
1100	0.9	45	7.5	20

**Ceracomp Co., Ltd.**

**Piezoelectric Single Crystals and Superconducting Materials**

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