

# 第 19 回山梨エレクトロセラミックスセミナー

日 時：2014 年 7 月 29 日（火）14:00-15:30

場 所：情報メディア館 5 階多目的ホール

いつもお世話になっております。山梨大での研究活動の一環として、国内外の電子セラミックスの分野で活躍されている研究者の方々にその成果を発表していただく場として、新たに「山梨エレクトロセラミックスセミナー」を設立しました。その第 19 回として、以下の講演を行います。ぜひ、ご参加いただき、今後ともこの活動にご協力いただければ幸いです。



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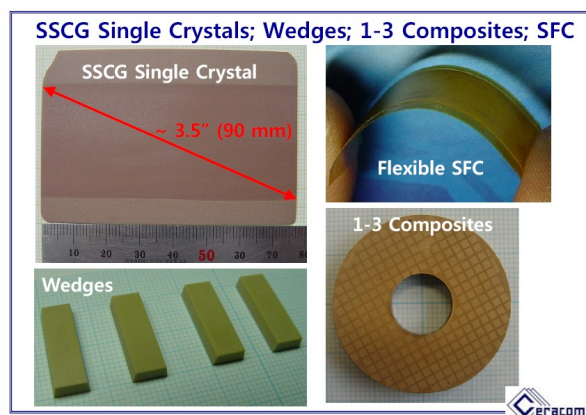
講演題目：「**“Lead-based” and “Lead-free” Piezoelectric Single Crystals Fabricated by “Low Cost” Solid-State Crystal Growth (SSCG) Method: Development and Application**” 低コスト”な固相結晶成長法により作製した鉛系&非鉛系圧電単結晶：その開発状況および応用」

## 講演概要

Crystallographically engineered Relaxor-PT single crystals, specifically PMN-PT and PZN-PT, offer much higher piezoelectric and electromechanical coupling coefficients ( $d_{33} > 1,500$  pC/N,  $k_{33} > 0.9$ ), when compared to PZT ceramics. Therefore, the high performance piezoelectric single crystals have been expected to replace polycrystalline PZT ceramics in many application fields such as ultrasound transducers (medical and NDA), SONAR transducer, piezoelectric actuators, piezoelectric sensors, ultrasonic motors and piezoelectric energy harvesting, etc. Ceracomp Co., Ltd. (South

Korea) has developed the solid-state single crystal growth (SSCG) technique for fabricating the high performance “lead (Pb)-based” piezoelectric single crystals such as PMN-PT and PMN-PZT. Since the SSCG process is quite simple and similar to conventional sintering process, compared to conventional single crystal growth methods such as flux and Bridgman methods, it is very cost-effective and suitable to mass production. And recently the SSCG method was successfully applied to growth of “lead (Pb)-free” piezoelectric single crystals of high electromechanical coupling coefficients ( $k_{33} > 0.85$ ). In this presentation the recent progress on development and application of piezoelectric single crystals (“lead-based” as well as “lead-free”) using the “cost-effective” SSCG process will be reviewed.

\* Lee 教授は、現在固相結晶成長法による単結晶育成研究の世界 top の方です。



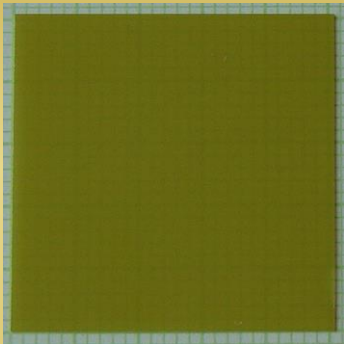
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## High Performance Ferroelectric and Piezoelectric Single Crystals (BaTiO<sub>3</sub>, (Ba,Sr)TiO<sub>3</sub>, Ba(Zr,Ti)O<sub>3</sub>, PMN-PT and PMN-PZT)

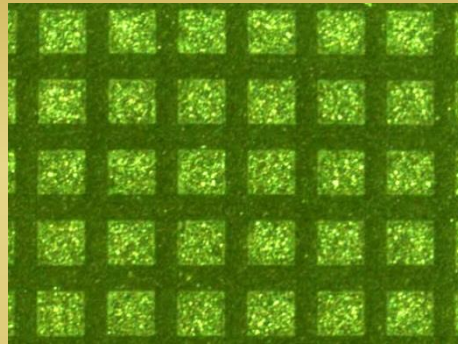
**Ceracomp Co. Ltd.** announces the release of piezoelectric PMN-PT and PMN-PZT single crystals, which are fabricated by the cost-effective solid-state crystal growth (SSCG) method. Their excellent dielectric and piezoelectric properties make them the best candidates for sensors, transducers, actuators,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

PMN-PT and PMN-PZT single crystals are available with lateral dimensions up to 60 mm. High T<sub>C</sub> PMN-PZT single crystals (T<sub>C</sub>>200°C) are also available by request.

**Single Crystal Wafer**



**"1-3" Composite**



**"Flexible" Macro Fiber Composite**



### Typical Properties of (001) PMN-29PT and PMN-PZT (CPSC[T<sub>C</sub>]-[T<sub>RT</sub>]; HPSC[T<sub>C</sub>]-[T<sub>RT</sub>])

	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 $\delta$ , %]	< 1.0	< 1.0	< 1.0	< 1.0	< 0.5	< 0.5
Curie Temperature [T <sub>C</sub> , °C]	130	160	180	200	180	200
<b>R-T Transition Temp. [T<sub>RT</sub>, °C]</b>	<b>90</b>	<b>95</b>	<b>120</b>	<b>145</b>	<b>120</b>	<b>145</b>
EM Coupling Factor [k <sub>33</sub> ]	0.90	0.93	0.93	0.92	0.9	0.9
Piezoelectric Const. [d <sub>33</sub> , pC/N]	1,500	2,000	1,850	1,500	1,300	1,100
EM Coupling Factor [k <sub>32</sub> ] - (011)	0.87	0.91	0.90	0.90	0.88	0.86
Piezo. Const. [d <sub>32</sub> , pC/N] - (011)	-1,350	-1,850	-1,650	-1,400	-1,200	-900
Coercive Electric Field [E <sub>C</sub> , kV/cm]	2.5	4	4	5	5	6
Mechanical Quality Factor [Q <sub>m</sub> ]	100	100	100	100	> 500	> 1,000

Please visit "[www.ceracomp.com](http://www.ceracomp.com)".