

Takaaki TSURUMI Prof.
Department of Metallurgy and Ceramic Science,

1. Main Research Results

A prototype of piezoelectric vibration-energy-harvester was developed using lead-free piezoelectric ceramics, and the relationship between device performance and material properties was clarified, which will be valuable information for designing piezoelectric materials for the vibration-energy-harvester. A sensor for the simultaneous detections of methanol content and flow rate has been demanded in bio-methanol industry. We have developed a new ultrasonic sensor detecting methanol content in aqueous solutions and flow rate by improving signal processing software used in conventional ultrasonic flow sensors. As for photonic materials, we have developed a one-dimensional photonic crystal composed of lanthanum-doped lead zircon titanate (PLZT) and conductive zinc oxide as a new type of tunable photonic crystal. The result of simulation indicated that the electro-optic effect of PLZT was markedly enhanced by the effects of multi-layer effect and the formation of photonic band gap.

2. List of Publications

Original articles

- 1) Fabrication and positive temperature coefficient of resistivity properties of semiconducting ceramics based on the $\text{BaTiO}_3\text{-(Bi}_{1/2}\text{K}_{1/2})\text{TiO}_3$ system, Hiroaki Takeda, Hisashi Harinaka, Tadashi Shiosaki, M. A. ZUhair, Colin Leach, Robert Freer, Takuya Hoshina, Takaaki Tsurumi, *Journal of the European Ceramic Society*, Vol. 30, No. 2, pp. 555-559, 2010.
- 2) Development of Environmental-Friendly Lead-Free Piezoelectric Materials for Actuator Uses, Hiroaki Takeda, Enzhu Li, Takashi Nishida, Takuya Hoshina, Takaaki Tsurumi, Springer London, pp. 425-438, 2010.
- 3) Birefringence and Electro-optic Effect in Epitaxial BST Thin Films, Koutarou Takeda, Tomomitsu Muraishi, Takuya Hoshina, Hirofumi Kakemoto, Takaaki Tsurumi, *Materials Science & Engineering B*, Vol. 161, pp. 61-65, 2009.
- 4) Polarization behavior in diffuse phase transition of $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ ceramics, Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *J. Appl. Phys.*, Vol. 105, p. 054111, 2009.
- 5) Effect of depletion layers on scaling effect in barium strontium titanate epitaxial films, Naohiro Horiuchi, Takatoshi Matsuo, Takuya Hoshina, Hirofumi Kakemoto, Takaaki Tsurumi, *Appl. Phys. Lett.*, Vol. 94, p. 102904, 2009.
- 6) Dielectric, piezoelectric, and electromechanical phenomena in $(\text{K}_{0.5}\text{Na}_{0.5})\text{NbO}_3\text{-LiNbO}_3\text{-BiFeO}_3\text{-SrTiO}_3$ ceramics, Enzhu Li, Suzuki Ryo, Takuya Hoshina,

- Hiroaki Takeda, Takaaki Tsurumi, *Appl. Phys. Lett.*, Vol. 94, p. 132903, 2009.
- 7) Ultrawideband dielectric spectroscopy of BaZr_xTi_{1-x}O₃ ceramics and its microscopic mechanism of polarization, Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *J. Appl. Phys.*, Vol. 105, p. 114102, 2009.
 - 8) Preparation of barium titanate nanocube particles by solvothermal method and their characterization, Satoshi Wada, A. Nozawa, Masaru Ohno, Hirofumi Kakemoto, Takaaki Tsurumi, Yoshikazu Kameshima, Yoko Ohba, *Journal of Materials Science*, 2009.
 - 9) Controlling factors of film-thickness in improved aerosol deposition method, Kensuke Mihara, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *Journal of the Ceramic Society of Japan*, Vol. 117, No. 1368, pp. 868-872, 2009.
 - 10) Size Effect of Barium Titanium and Computer-Aided Design of Multilayered Ceramic Capacitors, Takaaki Tsurumi, Takuya Hoshina, Hiroaki Takeda, Youichi Mizuno, Hirokazu Chazono, *IEEE Transaction of Ultrasonics, Ferroelectrics, and Frequency Control*, Vol. 56, No. 8, pp. 1513-1522, 2009.
 - 11) Domain Contribution to Dielectric Properties of Fine-Grained BaTiO₃ Ceramics, Takuya Hoshina, Youichi Kigoshi, Saki Hatta, Hiroaki Takeda, Takaaki Tsurumi, *Japanese Journal of Applied Physics*, Vol. 48, p. 09KC01, 2009.
 - 12) Miniature Ultrasonic Motor Using Shear Mode of Potassium Sodium Niobate-Based Lead-Free Piezoelectric Ceramics, Enzhu Li, Ryo Sasaki, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *Japanese Journal of Applied Physics*, Vol. 48, p. 09KD11, 2009.
 - 13) *Nanoscale Physics for Materials Science*, Takaaki Tsurumi, Hiroyuki Hirayama, Martin Vacha, Tomoyasu Taniyama, CRC Press (Taylor & Francis), 2009.
 - 14) Fabrication of Dielectric/Conductive Hybrid Artificial Superlattices using Molecular Beam Epitaxy Method, Yuu Yonezawa, Hiroyuki Kinbara, Hiroki Umehara, Hirofumi Kakemoto, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *Key Engineering Materials*, Vol. 421-422, pp. 139-142, 2009.
 - 15) Effects of Pretreatments on deposition rate of Films in Aerosol Deposition Method, Kensuke Mihara, Takuya Hoshina, Hirofumi Kakemoto, Hiroaki Takeda, Takaaki Tsurumi, *Key Engineering Materials*, Vol. 421-422, pp. 165-168, 2009.
 - 16) Wide Range Dielectric Spectroscopy of Barium Strontium Titanate Ceramics, Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, *Key Engineering Materials*, Vol. 421-422, pp. 273-276, 2009.
 - 17) Size Effect and Domain-Wall Contribution of Barium Titanate Ceramics, Takuya Hoshina, Yoichi Kigoshi, Saki Hatta, Takashi Teranishi, Hiroaki Takeda, and Takaaki Tsurumi, *Ferroelectrics*, 2010. in press.
 - 18) Mechanism of Stacking-Layer Effect of Dielectric Properties of Multilayer Ceramic Capacitors,

Satoshi Yokomizo, Takuya Hoshina, Hiroaki Takeda, Katsuya Taniguchi, Youichi Mizuno¹, Hirokazu Chazono, Takaaki Tsurumi, Japanese Journal of Applied Physics, 2010. in press.

- 19) Growth and Piezoelectric Properties of Ferroelectric Bi₂WO₆ Mono-domain Crystals, H. Takeda, J. S. Han, M. Nishida, T. Shiosaki, T. Hoshina, and T. Tsurumi, Solid State Comm., 2010. in press.
- 20) Wide Band Dielectric Spectroscopy at Ferroelectric Phase Transition of BaTiO₃ Ceramics, Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, Japanese Journal of Applied Physics, Vol.49 No.4, 2010.

review article/books

- 1) Takaaki Tsurumi, Dielectric and optical properties of perovskite artificial superlattices, Chapter 32, Handbook of advanced dielectric, piezoelectric and ferroelectric materials, Edited by Zuo-Guang Ye, (Woodhead Pub., Cambridge, 2009)

3. List of Invited Presentations

3-1. International Conference or Workshop

- 1) Takaaki Tsurumi, Takuya Hoshina, Hiroaki Takeda, "Size Effect and Domain Contribution in Barium Titanate", April 20, 2009, IMAPS/ACerS 5th CICMT[Oral Presentation]
- 2) Hitoaki Takeda, Takuya Hoshina, Takaaki Tsurumi, "Synthesis and Characterization of (B_{1/2}A_{1/2})Modified BaTiO₃(A=Na,K)Semiconducting Ceramics", April 20, 2009, IMAPS/ACerS 5th CICMT [Oral Presentation]
- 3) Takaaki Tsurumi, "Current Status and Devise Applications of Lead-free Piezoelectric Ceramics", May 12, 2009, U.S.Navy Workshop[Invited]
- 4) Takaaki Tsurumi, Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, "Dispersion and Mechanism of Diffuse Phase Transition in BST Ceramis" May 31, 2009, PacRim8[Invited]
- 5) Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, "Dielectric and Piezoelectric Properties of Fine-grained Barium Titanate Ceramics", May 31, 2009, PacRim8[Oral Presentation]
- 6) Naohiro Horiuchi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, "Effcect of Interfaces on Tunabillity in Barium Strontium Titanate Thin-Film Capacotpr", May 31, 2009, PacRim8[Oral Presentation]
- 7) Takaaki Tsurumi, "Material Properties Related with Polarization Mechanisms in Perovskite Ferroelectrics", August 23, 2009, IMF-ISAF-2009[Plenary Talk]
- 8) H. Takeda, M. Hagiwara, E. Li, R. Sasaki, S. Suzuki, T. Hoshina and T. Tsurumi,

- “Characterization of Share Mode Resonators Using Potassium Sodium Niobate-based Ceramics and Their Application to Ultrasonic Motors”, August 23, 2009, IMF-ISAF-2009[Oral Presentation]
- 9) “Size Effect and Domain-wall Contribution of Marium Titanate Ceramics”, August 23, 2009, IMF-ISAF-2009[Oral Presentation]
 - 10) Enzhu Li and Takaaki Tsurumi, “Enhanced Piezoelectric Properties of Niobate Based Lead-free Ceramics by BiFeO₃ and SrTiO₃ Substitution”, August 23, 2009, IMF-ISAF-2009[Oral Presentation]
 - 11) K. Takeda, T. Hoshina, H. Takeda and T. Tsurumi, “Analysis of Electro-Optic Effect Originated from Piezoelectric Displacement in LiNbO₃ Single Crystal near Resonance Frequency”, August 23, 2009, IMF-ISAF-2009[Oral Presentation]
 - 12) “Effect of Ca and Zr incorporation into BaTiO₃ ceramics on their electrical properties”, August 23, 2009, IMF-ISAF-2009[Oral Presentation]
 - 13) Takaaki Tsurumi, “Interfacial Polarization Enhanced in Dielectric/Conductive Hybrid Artificial Superlattices”, October 11, 2009, 14th US-Japan Seminar [Oral Presentation]
 - 14) Hiroaki Takeda, Ryo Sasaki, Enzhu Li, Takuya Hoshina, Takaaki Tsurumi, "Fabrication of Small Diameter Ultrasonic Motors Using (K,Na)NbO₃-based Lead-free Piezoelectric Ceramics", October 11, 2009, 14th US-Japan Seminar[Oral Presentation]
 - 15) Takuya Hoshina and ???, “Domain-wall Contribution to the Dielectric and Piezoelectric Properties of Fine-Grained Barium Titanate Ceramics”, October 11, 2009, 14th US-Japan Seminar [Oral Presentation]
 - 16) Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, “Ultrawide band dielectric spectroscopy and polarization mechanism of BaTiO₃-based ferroelectrics”, October 11, 2009, 14th US-Japan Seminar[Oral Presentation]
 - 17) Takaaki Tsurumi, “??”, December 8, 2009, JSPS Asian Science Seminar[Invited]
 - 18) Takashi Teranishi, Takuya Hoshina, Hiroaki Takeda and Takaaki Tsurumi, “Wide Band Dielectric Spectroscopy in Perovskite Ferroelectrics”, December 8, 2009, JSPS Asian Science Seminar[Oral Presentation]
 - 19) Takaaki Tsurumi, Takuya Hoshina and Hiroaki Takeda, “3D Material Integration of Ceramics/Polymer Composites for Future RF-Modules”, November 9, 2009, IWPMA-ISE2009[Invited]
 - 20) Haohiro Horiuchi, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, “Tunability of Barium Strontium Titanate Thin-film Capacitor with different metal electrodes”, November 24, 2009,
 - 21) Youn Kyu Choi, Jung Sang Han, Takuya Hoshina, Hiroaki Takeda, Takaaki Tsurumi, Effect of Ca and Zr incorporation into (Ba_{1-x}Ca_x)_m(Ti_{1-y}Zr_y)₃ ceramics, November 24, 2009,