Symposium 9C

Symposium 9C: Ceramics for Electricity; Direct Conversion Technology between Heat and Electricity

Main Organizers
- Ryoji Funahashi, AIST, Japan
- Kunihito Koumoto, Nagoya University, Japan

Co-Organizers
- Shinsuke Yamanaka, Osaka University, Japan
- Terry Tritt, Clemson University, USA
- George Nolas, University of South Florida, USA
- Lidong Chen, Shanghai Institute of Ceramics, Chinese Academy of Sciences, China
- Won Seon Seo, Korea Institute of Ceramic Engineering & Technology, Korea
- Harald Bottner, Fraunhofer Institute for Physical Measurement Techniques, Germany
- Antoine Maignan, Laboratoire CRISMAT/ENSICAEN, France

Oral Session

Wednesday, November 17

Room: 1008

9:00 - 10:30: Oxide I

Chair: Ichiro Terasaki (Nagoya University, Japan)

9:00 - 9:15
S9C-001 **Microstructure Control of Nano Phase-Separated Co-Mn-O System and its Effects on Thermoelectric Properties**
A. Kosuga[1,2], K. Yubuta[3], Y. Wang[4], K. Kurosaki[5], S. Yamanaka[5], K. Koumoto[4,6], R. Funahashi[2,6]; [1]Osaka Prefecture University, Japan, [2]National Institute of Advanced Industrial Science and Technology, Japan, [3]Tohoku University, Japan, [4]Nagoya Universitym, Japan, [5]Osaka University, Japan, [6]Japan Science and Technology Agency, Japan

9:15 - 9:30
S9C-002 **Thermoelectric Properties of Perovskite-type Oxide System $Ca_{1-x}Nd_{2x/3}V_{x/3}MnO_3$ Having A-site Vacancy**
H. Kawakami, M. Anzai, M. Saito, H. Yamamura; Kanagawa University, Japan

9:30 - 9:45
S9C-003 **Thermoelectric Properties and Figure of Merit of La-Doped (Ba,Sr)SnO_3 Solid Solutions**
M. Yasukawa[1], T. Kono[2], K. Ueda[3], H. Yanagi[4], S. W. Kim[5], H. Hosono[5]; [1]Kochi National College of Technology, Japan, [2]Kochi Prefectural Industrial Technology Center, Japan, [3]Kyushu Institute of Technology, Japan, [4]University of Yamanashi, Japan, [5]Tokyo Institute of Technology, Japan

9:45 - 10:00
S9C-004 **Thermal and Electrical Properties of Metal Oxides with Rattling Cations in Cage-like Structure**
M. Ohtaki, S. Miyaishi; Kyushu University, Japan

10:00 - 10:30
S9C-005 **Structures and Thermoelectric Properties of Indium Based Oxide Compounds (Invited)**
E. Guilmeau, S. D. Bhame, T. Zhou, B. Raveau; Laboratorie CRISMAT, France

10:30 - 10:45 **Break**

10:45 - 12:15: Oxide II

Chair: Emmanuel Guilmeau (CRISMAT Laboratory, France)

10:45 - 11:15

S9C-006 **Thermoelectricity Enhanced by Spin-State Disorder in the Perovskite Oxide $La_{1-x}Sr_xCo_{1-y}Rh_yO_3$ (Invited)**

I. Terasaki[1], S. Shibasaki[2], S. Asai[1], N. Furuta[1], Y. Yasui[1]; [1]Nagoya University, Japan, [2]Waseda University, Japan

11:15 - 11:30

S9C-007 **Monolithic Micro ThermoElectric Generator Based on Multi Layer Ceramic Capacitor Technology**

S. Funahashi, S. F. Hayashi, T. Nakamura, K. Kageyama; Murata Manufacturing Co.,Ltd., Japan

11:30 - 11:45

S9C-008 **Role of Nb-doped Grain Boundaries in Nano-grained Thermoelectric Ceramics of La-doped $SrTiO_3$**

Y. Wang[1], C. Wan[1,2], N. Wang[1], Y. Ba[1], K. Koumoto[1,2]; [1]Nagoya University, Japan, [2]Japan Science and Technology Agency, Japan

11:45 - 12:00

S9C-009 **Local Magnetic Properties in the CoO_2 Layer in Layered Thermoelectric Cobalt Dioxides**

T. Takami[1], M. Itoh[1], H. Nozaki[2], H. Itahara[2], J. Sugiyama[2]; [1]Nagoya University, Japan, [2]Toyota Central Research and Development Labs. Inc., Japan

12:00 - 12:15

S9C-010 **Large Anisotropic Thermoelectricity in the Perovskite Related Layered Structure: $Sr_nNb_nO_{3n+2}$ (n=4, 5)**

A. Sakai, K. Takahashi, H. Adadchi, T. Kanno; Panasonic Corporation, Japan

13:30 - 15:00: Chalcogenide

Chair: Clotilde Boulanger (Universite Paul Verlaine Metz LEM IJL, France)

13:30 - 13:45

S9C-011 **Low-Thermal-Conductivity $(MS)_{1+x}(TiS_2)_2$ (M = Pb, Bi, Sn) Misfit Layer Compounds for Bulk Thermoelectric Materials**

C. Wan[1,2], Y. Wang[1,2], N. Wang[1], K. Koumoto[1,2]; [1]Nagoya University, Japan, [2]Japan Sciece and Technology Agency, Japan

13:45-14:00

S9C-012 **Effect of Transition Metal Filling on Thermoelectric Properties of Chevrel Phase Sulfides**

M. Ohta, A. Yamamoto, H. Obara, M. Kunii, H. Nishiate, K. Ueno; National Institute of Advanced Industrial Science and Technology, Japan

14:00 - 14:15

S9C-013 **Effect of Vacancy Distribution on the Lattice Thermal Conductivity of Ga_2Se_3**

K. Kurosaki[1], C. Kim[1], M. Ishimarru[1], Y. Ohishi[1], H. Muta[1], S. Yamanaka[1,2]; [1]Osaka University, Japan, [2]University of Fukui, Japan

14:15 - 14:30

S9C-014 **Thermoelectric Properties of $GaSb$-Ga_2Te_3 and $InSb$-In_2Te_3 Alloys**

C. Kim[1], K. Kurosaki[1], Y. Usui[1], M. Ishimaru[1], H. Muta[1], S. Yamanaka[1,2]; [1]Osaka University, Japan, [2]University of Fukui, Japan

14:30 - 15:00

S9C-015 **Properties of Robust Thermoelectric Materials Prepared by Non-Equilibrium Synthesis Method for Energy Conversion (Invited)**

Q. Li; Brookhaven National Laboratory, USA

15:00 - 15:15 **Break**

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15:15 - 17:15: Bismuth Telluride and Silicide

Chair: Qiang Li (Brookhaven National Laboratory, USA)

15:15 - 15:45

S9C-016 **Electrodeposition Ability for Tailoring Morphology and Thermoelectric Behavior of Bismuth Telluride Nanowires (Invited)**

C. Boulanger[1], C. Frantz[1], N. Stein[1], Y. Zhang[2], L. Gravier[3]; [1]Université de Metz 1bd Arago, France, [2]Université de Metz Ile du Saulcy, France, [3]HEIG-Vd, Suisse

15:45 - 16:00

S9C-017 **Electrodeposition of of Bi_2Te_3 Based Thermoelectric Micro-pillar Arrays**

J.-F. Li, D.-W. Liu; Tsinghua University, China

16:00 - 16:15

S9C-018 **Preparation of β-$FeSi_2$ and $MnSi_{1.7+\delta}$ Bulks from Metal Compact Bodies Using a Na-Si Melt and Their Thermoelectric Properties**

T. Yamada, E. Kariya, H. Morito, Y. Miyazaki, J. Takahashi, H. Yamane; Tohoku University, Japan

16:15 - 16:30

S9C-019 **Valence Electron Control in Higher Manganese Silicide $MnSi_y$**

Y. Miyazaki, Y. Saito, Y. Kikuchi, K. Hayashi, K. Yubuta, T. Kajitani; Tohoku University, Japan

16:30 - 16:45

S9C-020 **Structural Investigation and Thermoelectric Power of Fe-Si Compound**

A. Sakulkalavek, S. Kiatgamolchai; Chulalongkorn University, Thailand

16:45 - 17:15

S9C-021 **Advanced Thermoelectric Materials and Components for Radioisotope Thermoelectric Generators for Space Power Applications (Invited)**

T. Caillat; California Institute of Technology, USA

Thursday, November 18

Room: 1008

9:00 - 10:45: Skutterudite and Heusler

Chair: Toshihiro Takabatake (Hiroshima University, Japan)

9:00 - 9:15

S9C-022 **Thermoelectric Properties of $Tl_x(Co_{1-y}Rh_y)_4Sb_{12}$**

A. Harnwunggmoung[1,2], K. Kurosaki[1], H. Muta[1], S. Yamanaka[1,3]; [1]Osaka University, Japan, [2]Rajamangala University of Technology Suvarnabhumi, Thailand, [3]University of Fukui, Japan

9:15 - 9:30

S9C-023 **High Performance $In_xCe_yCo_4Sb_{12}$ Thermoelectric Materials with *In-Situ* Nanostructured InSb Phase**

H. Li[1], X. Tang[1], Q. Zhang[1], C. Uher[1,2]; [1]Wuhan University of Technology, China, [2]University of Michigan, USA

9:30 - 10:00

S9C-024 **What Do We Learn from Study on Multiple-filled Skutterudites? (Invited)**

W. Zhang[1], L. Chen[1], J. Yang[2], X. Shi[1], L. Xi[1], X. Shi[1]; [1]Chinese Academy of Sciences, China, [2]General Motors R&D, USA

10:00 - 10:30

S9C-025 **Development of Thermoelectric Materials Based on Fe_2VAl Heusler Compound for Energy Harvesting Applications (Invited)**

Y. Nishino; Nagoya Institute of Technology, Japan

10:30 - 10:45

S9C-026 **Origin of Large Thermoelectric Power in Off-stoichiometeric Fe_2VAl-based Alloys**

K. Soda[1], S. Harada[1], M. Kato[1], S. Yagi[1], Y. Sandaiji[2], Y. Nishino[2]; [1]Nagoya University, Japan, [2]Nagoya Institute of Technology, Japan

10:45 - 12:00: Clathrate and Others

Chair: Wenqing Zhang (Shanghai Institute of Ceramics, China)

10:45 - 11:15

S9C-027 **Tellurium-free Thermoelectric Module Based on a Clathrate Compound $Ba_8Ga_{16}Sn_{30}$ with p- and n-type Carriers (Invited)**

T. Takabatake[1], Y. Saiga[1], S. Deng[1], K. Suekuni[1], A. Yamamoto[2], K. Kishimoto[3], K. Nagase[2], H. Obara[2], K. Ueno[2], T. Koyanagi[3], K. Akai[1], Y. Kono[4], T. Taguchi[4], N. Ohya[4], K. Fukuda[5]; [1]Hiroshima University, Japan, [2]National Institute of Advanced Industrial Science and Technology, Japan, [3]Yamaguchi University, Japan, [4]DENSO Corp., Japan, [5]KELK Ltd., Japan

11:15 - 11:30

S9C-028 **Influence of Defect on the Thermoelectric Properties of YbB_6**

K. Kayamura[1], K. Inayoshi[1], H. Kitagawa[2], M. Takeda[1]; [1]Nagaoka University of Technology, Japan, [2]Shimane University, Japan

11:30 - 11:45

S9C-029 **Rapid Solidification Methods for Fabrication of Novel Thermoelectric Materials**

X. Tang[1], H. Li[1], W. Xie[1,3], Y. Yan[1], Q. Zhang[1], C. Uher[2], T. M. Tritt[3]; [1]Wuhan University of Technology, China, [2]University of Michigan, USA, [3]Clemson University, USA

11:45 - 12:00

S9C-030 **Thermoelectric Properties of Conducting Polyaniline/$BaTiO_3$ Nanoparticle Composite Films**

H. Anno[1], K. Yamaguchi[1], T. Nakabayashi[1], H. Kurokawa[2], F. Akagi[1], M. Hojo[1], N. Toshima[1]; [1]Tokyo University of Science, Yamaguchi, Japan, [2]Toda Kogyo Corp., Japan

13:15 - 14:30: Application I

Chair: Anke Weidenkaff (Empa, Swiss Federal Laboratories for Materials Science and Technology, Switzerland)

13:15 - 13:45

S9C-031 **Progress in TE Materials and Devices and Solar PV-TE Hybrid Power Generation System in China (Invited)**

Q.-J. Zhang; Wuhan University of Technology, China

13:45 - 14:00

S9C-032 **Application of High-Thermoelectric-Power Materials to Self-Cooling Device**

H. Nakatsugawa[1], Y. Okamoto[2], S. Yamaguchi[3], T. Kawahara[3]; [1]Yokohama National University, Japan, [2]National Defence Academy, Japan, [3]Chubu University, Japan

14:00 - 14:30

S9C-033 **A High Packing Density Micro-thermoelectric Power Generator Fabricated by Electrochemical MEMS Technology (Invited)**

W. Wang[1], Y.-T. Jin[1], Y.-B. Zhu[1], M. Bian[1], X. Liao[1], H. Li[2], J.-P. Gao[3]; [1]School of Chemical Engineering and Technology, China, [2]School of Material science and engineering, China, [3]School of Science Tianjin University, China

14:30 - 14:45 **Break**

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14:45 - 16:00: Application II

Chair: Hiroaki Anno (Tokyo University of Science, Yamaguchi, Japan)

14:45 - 15:00

S9C-034 **Thin Film Thermopile Array Generator Using Ceramic Catalytic Combustor**
W. Shin, T. Nakashima, M. Nishibori, N. Izu, T. Itoh, Y. Kinemuchi, Y. Fujishiro, I. Matsubara; National Institute of Advanced Industrial Science and Technology, Japan

15:00 - 15:30

S9C-035 **Development of Unconventional Thermoelectrics for Solar Energy Converters (Invited)**
A. Weidenkaff, M. Aguirre, N. Schäuble, P. Tomes, L. Karvonen, M. Trottmann; Empa, Switzerland

15:30 - 16:00

S9C-036 **Power Generation of Cascaded Thermoelectric Systems (Invited)**
R. Funahashi[1,2], S. Urata[1], T. Urata[1,2], Y. Matsumura[1], K. Iwasaki[1]; [1]National Institute of Advanced Industrial Science and Technology, Japan, [2]Japan Science and Technology Agency, Japan

Poster Session

Tuesday, November 16

Room: Event Hall

12:00 - 14:00

S9C-P001 **Thermoelectric Properties of Sb-doped Mg_2Si Prepared by Solid State Synthesis**
J.-Y. Jung, K.-H. Park, I.-H. Kim; Chungju National University, Korea

S9C-P002 **Thermoelectric Properties of Single Crystalline Clathrate Ba8AlxSi46-x**
N. Mugita, Y. Nakakohara, T. Motooka, R. Teranishi, S. Munetoh; Kyushu University, Japan

S9C-P003 **Theremoelectric Properties and Oxidation Behavior of Magnesium Silicide**
J. Tani, M. Takahasi, H. Kido; Osaka Municipal Technical Research Institute, Japan

S9C-P004 **Thermoelectric Properties of β-$FeSi_2$ Based Dispersed and Nanodispersed HIPed Bodies**
S. Nishiyama, Y. Sakurai, T. Umetsu; Chiba University, Japan

S9C-P005 **Preparation and Thermoelectric Properties of $(Mn_{1-x}Cr_x)Si_\gamma$ ($\gamma \sim 1.7$) Solid Solution**
Y. Kikuchi, Y. Saito, K. Hayashi, Y. Miyazaki, K. Yubuta, T. Kajitani; Tohoku University, Japan

S9C-P006 **Thermoelectric Characteristics of Doped Mg_2Si Fabricated by Spark Plasma Sintering Method**
K. H. Kim[1], S. M. Choi[1], I. H. Kim[2], S. U. Kim[3], W. S. Seo[1]; [1]Korea Institute of Ceramic Engineering and Technology, Korea, [2]Chungju National University, Korea, [3]Research Institute of Industrial Science and Technology, Korea

S9C-P007 **Effect of Na Addition on Electric Properties of Ca_2Si Sintered Compacts**
C. Wen[1], T. Nonomura[1], A. Kato[2], K. Isobe[3], Y. Kubota[1], T. Nakamura[1], Y. Hayakawa[1], H. Tatsuoka[1]; [1]Shizuoka University, Japan, [2]FDK Corporation, Japan, [3]Industrial Research Institute of Shizuoka Prefecture, Japan

S9C-P008 **Syntheses and Electrical Properties of Hexagonal Phase Group VI Metal Silicide Powders, Sintered Compacts and Bulk Crystals**
T. Nonomura[1], C. Wen[1], M. Yamashita[1], K. Isobe[2], A. Kato[3], Y. Kubota[1], T. Nakamura[1], Y. Hayakawa[1], H. Tatsuoka[1]; [1]Shizuoka University, Japan, [2]Industrial Research Institute of Shizuoka Prefecture, Japan, [3]FDK Corporation, Japan

S9C-P009 **Electrical and Mechanical Properties of a $MoSi_2$-WSi_2-Alumomagnesium Silicate Composite**
D. Titov[1], Y. Kargin[1], N. Popova[2], V. Gorshkov[3]; [1]IMET RAS, Russia, [2]Mendeleyev University of Chemical Technology, Russia, [3]ISMAN RAS, Russia

S9C-P010 Structural and Thermoelectric Properties of Sintered Silicon Clathrates: $Ba_{8-x}A_xGa_{16}Si_{30}$ (A=Sr, Eu; x=0-2) Nominal Compositions
T. Nakabayashi[1,3], M. Hokazono[1,3], H. Anno[1,3], Y. Ba[2,3], K. Koumoto[2,3]; [1]Tokyo University of Science, Yamaguchi, Japan, [2]Nagoya University, Japan, [3]Japan Science and Technology Agency, CREST, Japan

S9C-P011 The Characteristics and Growth Mechanism of Bi_2Te_3 Thin Film Grown on ITO Glass Substrate
J.-Y. Yang[1], M.-H. Lin[2], S.-T. Choi[3], W.-C. Jhong[3], T.-C. Cheng[2], W.-H. Lin[2]; [1]National Nano Device Laboratories, Taiwan, [2]National Kaohsiung University of Applied Sciences, Taiwan, [3]National Cheng Kung University, Taiwan

S9C-P012 The Thermoelectric Performance of Nano-SiC Doped $Bi_{0.3}Sb_{1.7}Te_3$ Composites at Low Temperature
M. Zhou, Z. Chen, L. Li; Chinese Academy of Sciences, China

S9C-P013 Preparation and Thermoelectric Properties of $Ru_{1-x}Fe_xAl_2$
S. Takahashi[1], H. Muta[1], K. Kurosaki[1], S. Yamanaka[1,2]; [1]Osaka University, Japan, [2]University of Fukui, Japan

S9C-P014 Doping Effects on Thermoelectric Properties of Off-Stoichiometric Fe_2VAl Alloys
Y. Tamada, Y. Sandaiji, Y. Nishino; Nagoya Institute of Technology, Japan

S9C-P015 Transport Properties of $ZrNi_{1.05}Sn$ Half-Heusler Compound
H. Muta[1], K. Furo[1], Y. Ohishi[1], K. Kurosaki[1], S. Yamanaka[1,2]; [1]Osaka University, Japan, [2]University of Fukui, Japan

S9C-P016 Rietveld Refinement of Crystal Structure of β-Zn_4Sb_3 with Partial Substitution of In for Sb
S.-D. Cheng; Wuhan University of Technology, China

S9C-P017 Phase Transformation in In_4Se_3-In_4Te_3 Mixture and Its Effect on Thermoelectric Properties
J. Y. Cho[1,2], M. Jung[1], Y. S. Lim[1], W.-S. Seo[1], H.-H. Park[2]; [1]Korea Institute of Ceramic Engineering and Technology, Korea, [2]Yonsei University, Korea

S9C-P018 Thermoelectric Properties of $(AgSbTe_2)_{1-x}(Pb_{0.16}Ge_{0.84}Te)_x$ (x = 0.75, 0.80, 0.85, and 0.90)
A. Yusufu[1], K. Kurosaki[1], H. Muta[1], S. Yamanaka[1,2]; [1]Osaka University, Japan, [2]University of Fukui, Japan

S9C-P019 Synthesis of Bi_2Te_3 Nanosheets using Polyol Process
S. Nishiwaki, T. Itoh; Nagoya University, Japan

S9C-P020 Effect of Alloying on the Thermoelectric Properites of Divalent Hexaborides
K. Inayoshi, K. Iguchi, M. Takeda; Nagaoka University of Technology, Japan

S9C-P021 Preparation and Characterization of Planetary Ball Milled Si-based Clathrates and Their Spark Plasma Sintered Materials
R. Shirataki, M. Hokazono, T. Nakabayashi, H. Anno; Tokyo University of Science, Yamaguchi, Japan Science and Technology Agency, CREST, Japan

S9C-P022 Fabrication of Layered TiS_2-based Thermoelectric Elements by Using Centrifugal Heating Method
T. Aoki[1], C. L. Wan[2], H. Ishiguro[1], H. Morimitsu[1], K. Koumoto[2]; [1]Sinto Kogio, Ltd., Japan, [2]Nagoya University, Japan

S9C-P023 Controlling Independently the Electric and Thermal Properties by Shrinking the Particle Size down to Nanosize
T. Takami[1], M. Horibe[1], M. Itoh[1], J.-G. Cheng[2], J.-S. Zhou[2], J. B. Goodenough[2]; [1]Nagoya University, Japan, [2]University of Texas at Austin, USA

S9C-P024 Thermoelectric Properties of ZnMgO/ZnO Multilayer
M. Nishiguchi, K. Hayashi, Y. Miyazaki, T. Kajitani; Tohoku University, Japan

S9C-P025 Electrical Properties of Fe_2O_3 Added La_2CuO_4 Sintered Bodies
Y. Okada, S. Nishiyama; Chiba University, Japan

S9C-P026 Microstructure and Thermoelectric Properties of Cu-doped α-Fe_2O_3 for Power Generation
G. W. Lee[1], H. K. Hwang[1], Y. G. Choi[1], W. S. Seo[2], K. Park[1]; [1]Sejong University, Korea, [2]Korea Institute of Ceramic Engineering and Technology, Korea

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S9C-P027 **Electric and Thermoelectric Properties in $Cu_{1+x}Mn_{2-x}O_{4+\delta}$**
K. Fukao, H. Nakayama, N. Watnabe, F. Munakata; Tokyo City University, Japan

S9C-P028 **Thermoelectric Properties of Bulk Ga Doped ZnO**
P. Jood, G. Peleckis, X. L. Wang, S. X. Dou; University of Wollongong, Australia

S9C-P029 **Microstructure and High-temperature Thermoelectric Properties of $Zn_{1-x}Ce_xO$ ($0 \le x \le 0.02$)**
H. K. Hwang[1], Y. G. Choi[1], W. S. Seo[2], K. Park[1]; [1]Sejong University, Korea, [2]Korea Institute of Ceramic Engineering and Technology, Korea

S9C-P030 **Structure and Thermoelectric Properties of Double-Pervskite Oxides A_2FeMoO_6 and A_2MnMoO_6 with A-site Substitution**
T. Sugahara[1], M. Ohtaki[2], K. Kurosaki[1], H. Muta[1], Y. Ohishi[1], S. Yamanaka[1]; [1]Osaka University, Japan, [2]Kyushu University, Japan

S9C-P031 **Thermoelectric Properties of p-type Perovskite Compounds $LaCoO_3$ Systems Containing the A-site Vacancy**
M. Anzai, H. Kawakami, M. Saito, H. Yamamura; Kanagawa University, Japan

S9C-P032 **Microstructure and Thermoelectric Properties of Ag-added $Na(Co_{1-x}Ag_x)_2O_4$ ($0 \le x \le 0.25$) Thermoelectric Materials**
G. W. Lee[1], J. W. Choi[1], W.-S. Seo[2], K. Park[1]; [1]Sejong University, Korea, [2]Korea Institute of Ceramic Engineering and Technology, Korea

S9C-P033 **Crystal Growth and Power Factor of $Ba_{12}Co_{11}O_{33-\delta}$ Having a Pseudo–one–dimensional Structure**
K. Iwasaki[1], D. Kitagawa[2], S. Watanabe[2], M. Yoshino[2], T. Nagasaki[2], T. Matsui[2]; [1]Toyota Boshoku Corporation, Japan, [2]Nagoya University, Japan

S9C-P034 **n-type Oxide Thermoelectric Materials $(CaO)(CaMnO_3)_n$ ($n = 1, 2, 3 \& \infty$)**
X. Y. Huang[1], L. D. Chen[1], Y. Miyazaki[2], T. Kajitani[2]; [1]CAS, China, [2]Tohoku University, Japan