# Azuma-Yamamoto Lab

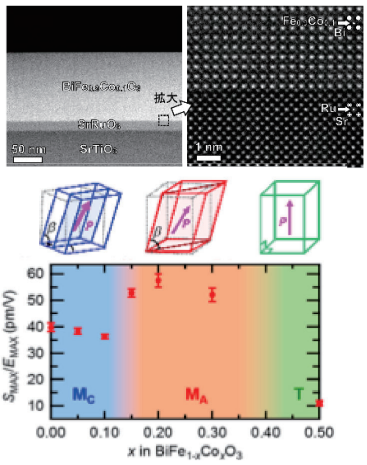
## Environmentally compatible functional oxide materials

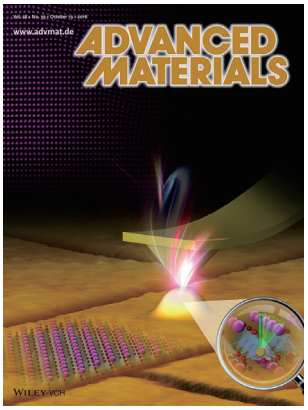
Division of Unexplored Materials Exploitation
Laboratory for Materials and Structures

http://www.msl.titech.ac.jp/~azumalab/

- Magnetization reversal by electric field in multiferroic materials
- Negative thermal expansion materials
- Designing novel functional mixed-anion materials

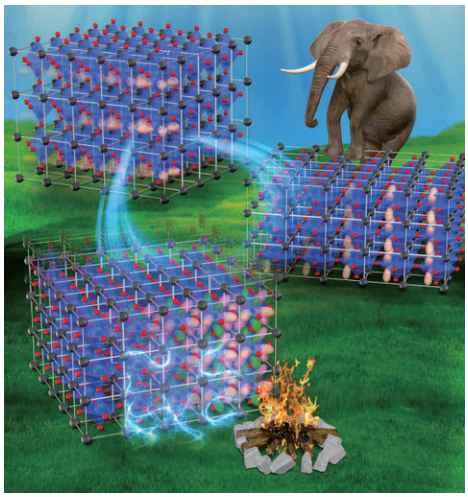
Transition metal oxides exhibit various useful functions such as magnetism, ferroelectricity and superconductivity. We realize new functional oxides as shown in the figures below by means of state-of-art synthesis techniques like high-pressure synthesis used for diamond synthesis, thin-film fabrication by laser ablating and topochemical reactions. We detect the tiny structural change accompanied with the occurrence of functions by using synchrotron X-ray and neutron beams. Such obtained information is applied to the design and the synthesis of further new materials.



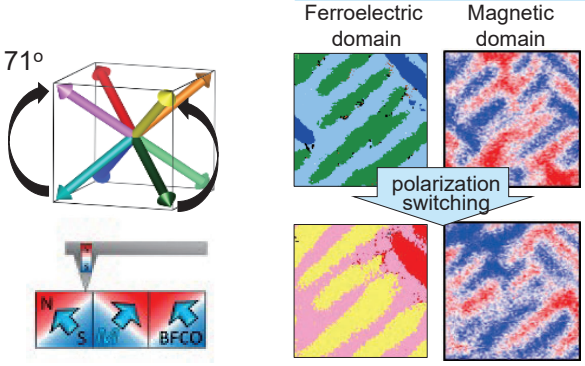

### Lead-free piezoelectric material

- We develop new lead-free piezoelectric materials as an alternative of PZT.
- We discovered that polarization rotation plays a crucial role in improving piezoelectric responses.



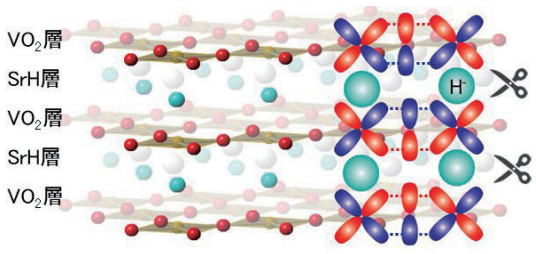
### Negative Thermal Expansion Materials

- They enable to suppress thermal expansion phenomena which is a problem on precise positioning in nanotechnology.
- We develop new materials exhibiting negative thermal expansion accompanied with charge-transfer or ferroelectric transition.




### Ferroelectric Ferromagnetism

- They exhibits combined nature of magnet and capacitor.
- We achieved magnetization reversal by only electric field, not by electric current where power lose is inevitable. We aim to develop a magnetic memory of ultra-low power consumption.




### Mixed-anion materials

- We explore new oxide-based mixed-anion compounds combined with nitrogen, fluorine or hydride to realize superior functionalities to conventional oxides.
- We create new functional materials by utilizing “hard” reaction such as high-pressure synthesis and/or “soft” reaction such as topochemical reaction.