Azuma-Yamamoto Lab

Environmentally compatible functional oxide materials

Division of Unexplored Materials Exploitation
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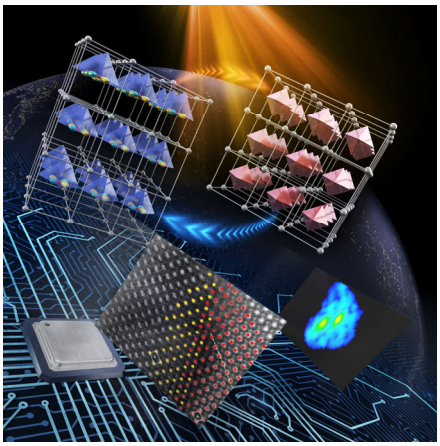
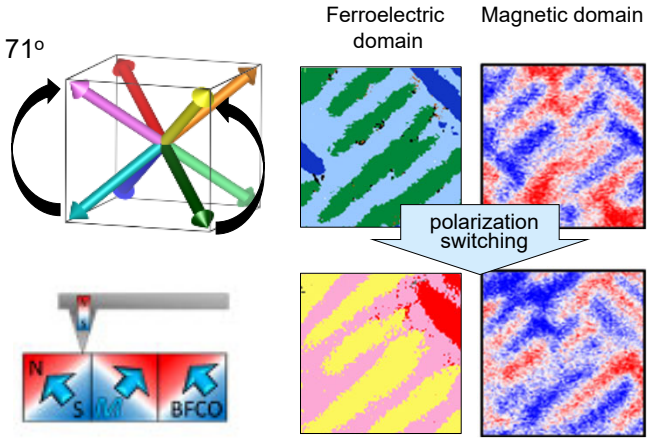
- Magnetization reversal by electric field in multiferroic materials
- Negative thermal expansion materials
- Designing novel functional mixed-anion materials

Transition metal oxides exhibit various useful functions such as magnetism, ferroelectricity and superconductivity. We realize new functional ceramics 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.



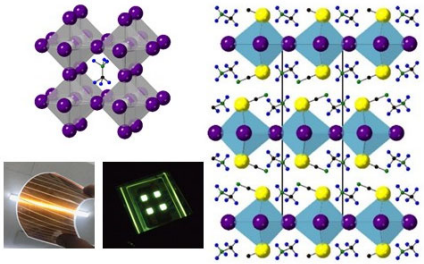
Negative Thermal Expansion Materials

- 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.



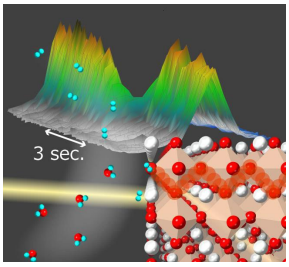
Ferroelectric Ferromagnetism

- 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.



Supra Ceramics

- We explore novel oxide-based mixed-anion compounds and organic-inorganic hybrid compounds in order to realize superior functionalities to conventional ceramics.
- We create new functional materials by utilizing “hard” reaction such as high-pressure synthesis and/or “soft” reaction such as topochemical reaction.



Mechanism of Inorganic Reactions

- We carry out state-of-the-art synchrotron X-ray techniques, including high-speed time-resolved XRD and high-pressure and high-temperature XRD measurements. The results will provide opportunities for gaining a better understanding and optimizing reactions in solid-state compounds.