RIES
Research Institute for Electronic Science
Hokkaido University

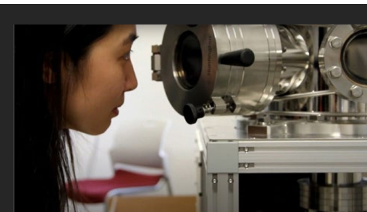
We develop useful things using ceramics

Research Institute for Electronic Science
Lab. of Functional Thin Film Materials

Ohta & Katayama Lab.

研究室見学はこちらから

YouTube



For more detail, please watch the YouTube movie.

Aims of the laboratory

In our laboratory, we focus on functional oxides, so called ceramics. We fabricate high-quality thin films with atomically flat surface using pulsed laser deposition technique. We extract the intrinsic performance of functional oxides. We challenge to develop novel devices.

Hiromichi Ohta
DOB 1971.9.21 (50)

Tsukasa Katayama
DOB 1988.6.10 (33)

Prof. Hiromichi Ohta

1. Development of oxide thermoelectric materials
2. Study on oxide thin film transistors
3. Development of advanced oxide memory devices

Associate Prof. Tsukasa Katayama

1. Multiferroic materials
2. Flexible oxide membrane

Hai Jun Cho
DOB 1986.11.7 (34)

Lab member

Professor 1, Associate Professor 1, Assistant Professor 1, Secretary 1, Postdoctoral fellow 1, Ph.D candidate 6, Master course 3, Undergraduate 4

Environment

Our rooms are located on the 3rd floor of the RIES building, located in N20W10. In the laboratory, there are thin film manufacturing equipment for making thin films and devices, atomic force microscopes and X-ray diffractometers for investigating the structure of the thin films. There are equipment in place for all basic analysis.

Skills acquiring in the laboratory

[1]Communication in English through the lab meeting (Language: English)
[2]Explanation skill: Students give presentations at conferences.
[3]Appealing skill: Publishing SCI journal papers (Master's course: more than 2 papers, Doctor's course: more than 3 papers)

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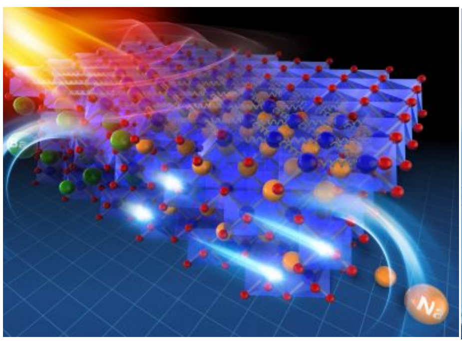
1. Thermoelectric materials

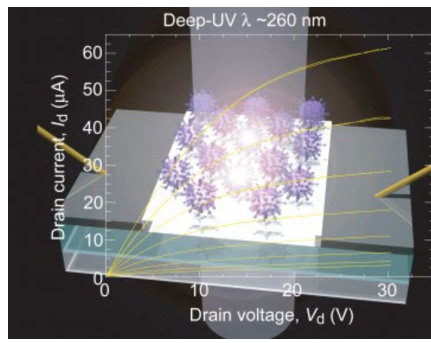
Thermoelectric energy conversion technology attracts great attention to convert the waste heat into electricity. Recently, metal oxides attract much attention as thermoelectric power generation material operating at high temperatures on the basis of their potential advantages over heavy metallic alloys in chemical and thermal robustness. We have fabricated high quality epitaxial films of oxide thermoelectric materials, which are suitable to clarify the intrinsic “real” properties. Now we are trying to clarify the origin of giant thermopower of extremely thin conducting oxide toward realization of truly practical oxide thermoelectric materials.



Record-setting thermoelectric figure of merit achieved for metal oxides

2. Transparent oxide semiconductors

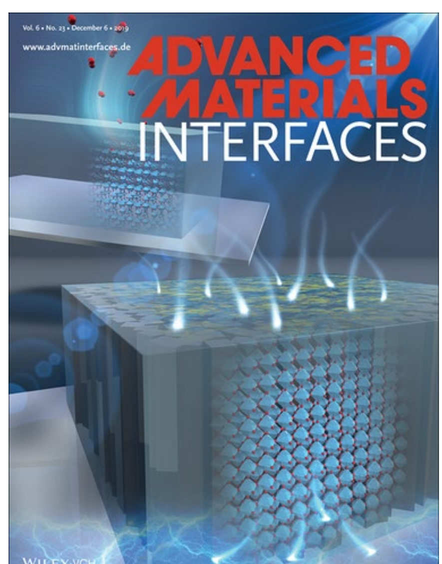
Transparent conducting oxides such as ITO (tin doped indium oxide) have been used as transparent electrodes for liquid crystal displays and OLED. Our laboratory is conducting research to develop transparent conductive oxide usable as a transparent oxide semiconductor. Specifically, we prepare high quality epitaxial thin films which enables fabrication of a laminated structure, realizing high carrier mobility, and materials that can be put into practical use by lowering the manufacturing cost. We also fabricate high-quality amorphous thin films at room temperature. These high quality thin films allow us to develop diodes and transistors that have been realized with compound semiconductors.



A transparent thin film transistor that transmits deep ultraviolet

3. Electrochemical materials and devices

The optic, electric, and magnetic properties of many transition metal oxides can be switched by their non-stoichiometry i.e. oxygen excess or deficiency and protonation. For example, $SrCoO_{2.5}$ with Brownmillerite structure is known as insulating non-magnet, but it can be changed into $SrCoO_3$ with Perovskite structure, which is ferromagnetic metal. For transition metal oxides, water is a strong reductant (H^+) as well as an oxidant (OH^-). Although such memory devices can be realized by using liquid electrolytes for electrochemical reaction, there is liquid leakage problem. We have developed “liquid-leakage-free water”, in which water molecules are infiltrated in a nano-porous glass. By using “liquid-leakage-free water”, we can switch optic, electric, and magnetic properties of transition metal oxides.



Visualization of the electrochemical oxidation reaction in materials for devices that store information with current and magnetism

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