Laboratory of Functional Thin Film Materials, RIES, Hokkaido University

http://functfilm.es.hokudai.ac.jp/english/

Affiliation of the students

Undergraduate: Department of Electronics and Information Engineering, School of Engineering, Hokkaido University

Graduate student: Course of Electronics for Informatics, Graduate School of Information Science and Technology, Hokkaido University

Research field

"Materials Science" for energy and electronics

1. Thermoelectric materials
2. Opto-electronic-magnetic memory devices
3. Transparent oxide semiconductors
4. Special epitaxial growth technique
5. Spintronics devices

Skills acquiring in the laboratory

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

Rules of the laboratory (Excerpt)

1. Start time: 9:00 (Closing time: 17:00)
2. Part-time job from Monday to Friday is prohibited.
3. Holidays in Summer and Winter: 5 days each

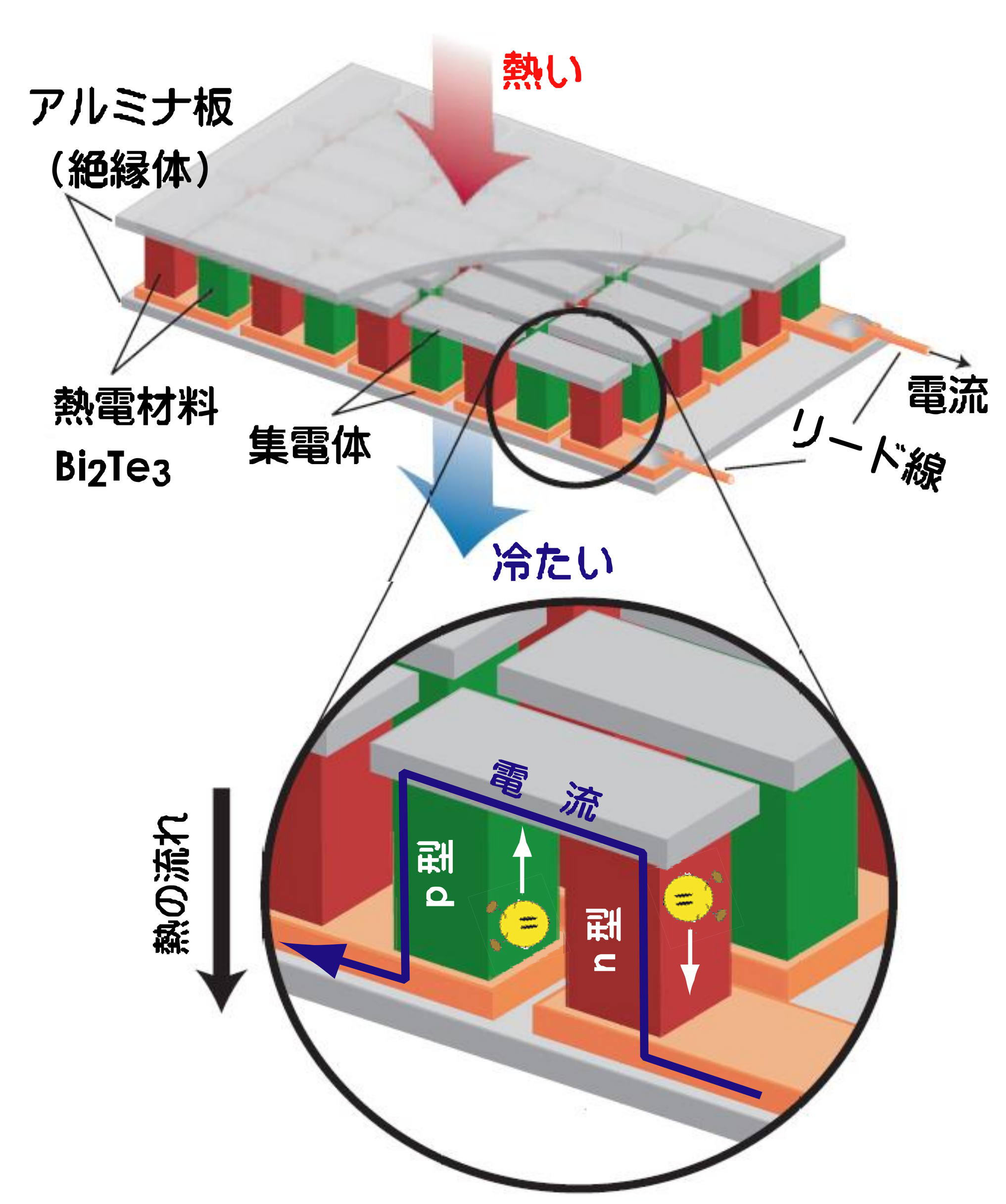
Place of employment

Asahi Kasei, Sumitomo Electric Industries, Murata Manufacturing, Hitachi, Shiseido, Fujifilm, Toyota Central R&D Labs

We develop useful things using ceramics

In our laboratory, we focus on functional oxides, so called ceramics. We fabricate high-quality thin films with atomically flat surface. We extract the intrinsic performance of functional oxides. We challenge to develop novel devices. Prof. Ohta is developing "Thermoelectric materials", "Optic, electric, and magnetic memory devices", "Transparent Oxide Semiconductors", and "Special epitaxial growth technique". Prof. Yamanouchi is developing "Spintronic devices" based on functional oxides.

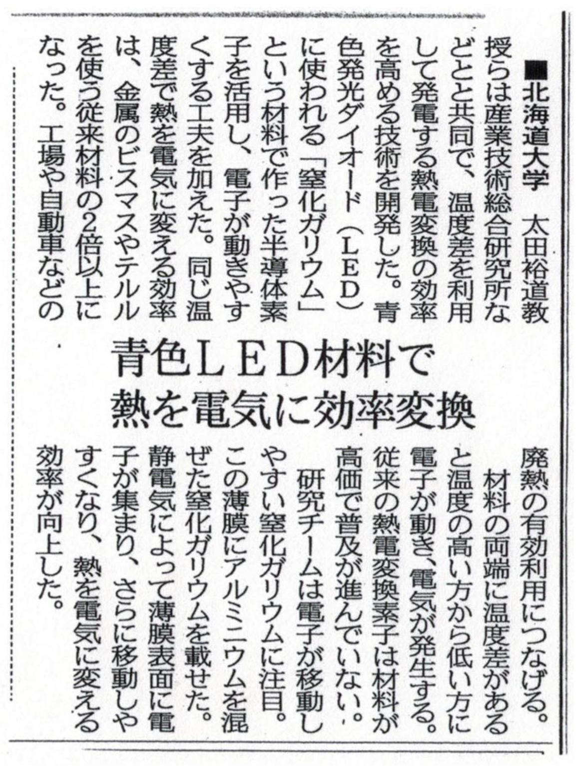
Thermoelectric materials



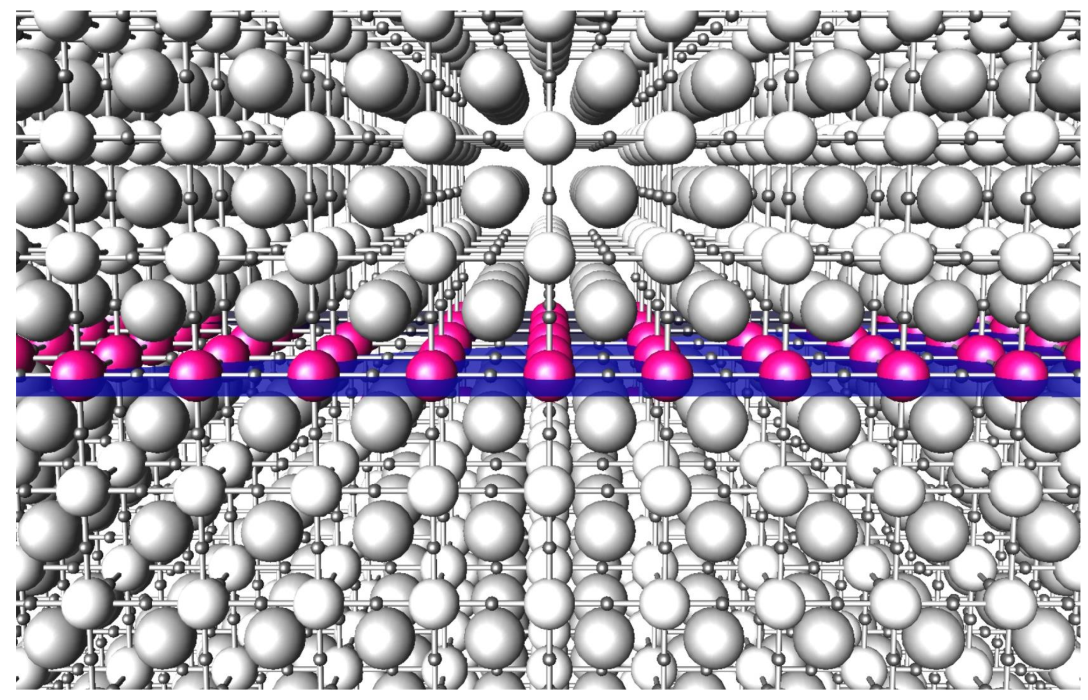
Thermoelectric energy conversion technology attracts great attention to convert the waste heat into electricity. Recently, metal oxides attract much attention as thermoelectric power generation material operating at high temperatures on the basis of their potential advantages over heavy metallic alloys 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.

Nikkan Kogyo (2018.6.28)

Nikkei (2017.12.4)



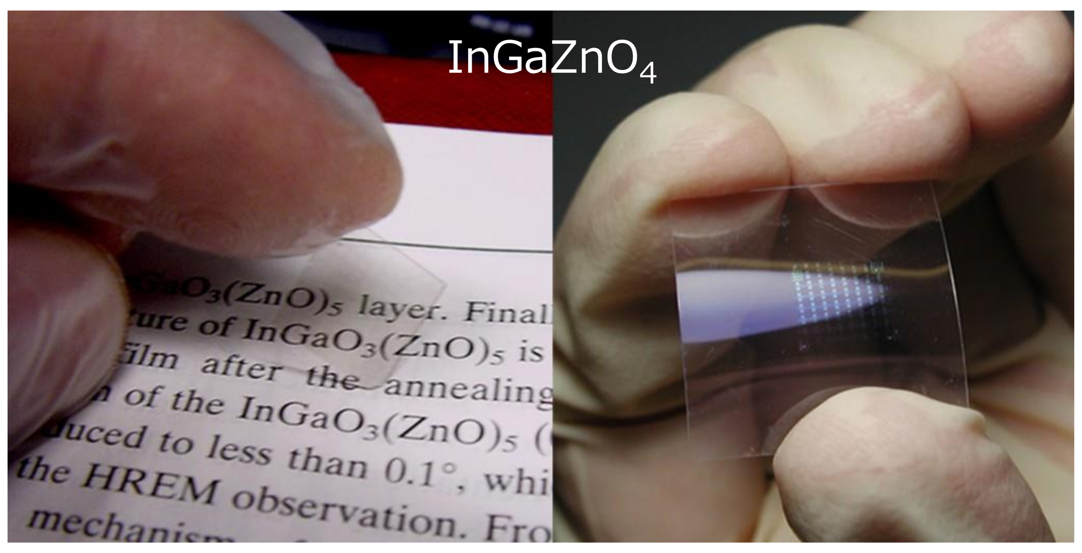
***Nature Commun.* 9**, 2224 (2018).



Electron sandwich doubles thermoelectric performance

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

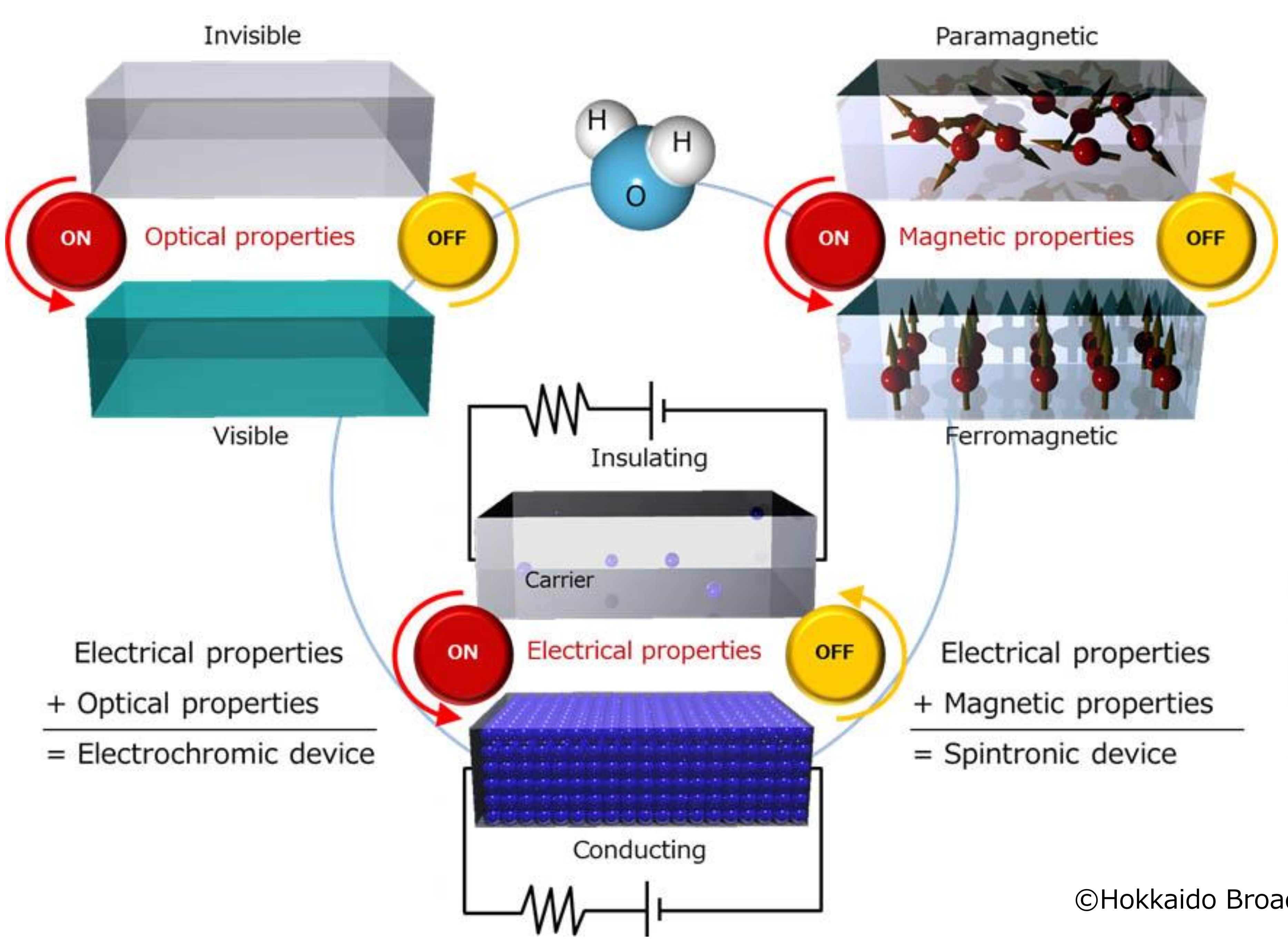


Practical OLED TV

LG

Yomiuri (2016.4.16)

Optic, electric, and magnetic memory 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, WO_3, known as an electro-chromic material, is basically transparent insulator, but it becomes blue colored metal by electrochemical protonation (H_xWO_3). $SrCoO_{2.5}$ 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.

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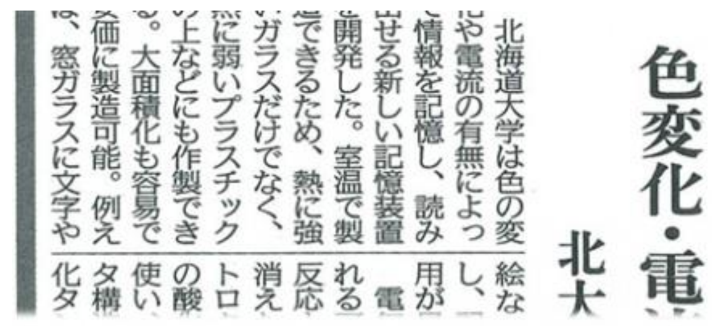
Nikkan Kogyo (2016.6.1)



Univ. Journal (2016.5.21)

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