

# Investigation of Local Structure and the Physics for Tailoring Novel Functional Materials

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## Background

- Functional ceramics are quite important research field for our life. Especially, construction of new functional materials are widely required in order to create innovative devices.
- The importance of research focus in 21 century is not only the "Advance" and/or "Convenient" but also the "Safety" and "Sustainable" for our life.

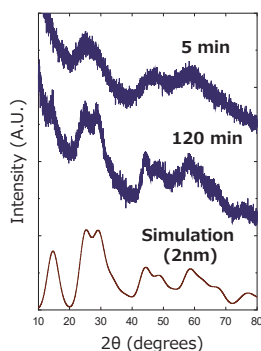
## Aim

- We focus on the local structure and the characteristic properties in the material.
- Bring out these local phenomena is my approach to create novel functional materials.
- Fabrication technique is also key for our research. We focus on the chemical synthesis technique for this issue, since it enable us to "design" and "tailor" new materials.

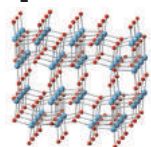
## Advanced Research Topics

### Research for TiO<sub>2</sub> Nano-Sized Phase

- TiO<sub>2</sub> is transparent semiconductor investigated in numerous scientific fields.
- TiO<sub>2</sub> has some crystal structures, but almost researches for this oxide focus only on "rutile" and "anatase" types of them.



### Crystal structure of TiO<sub>2</sub> nano-phase

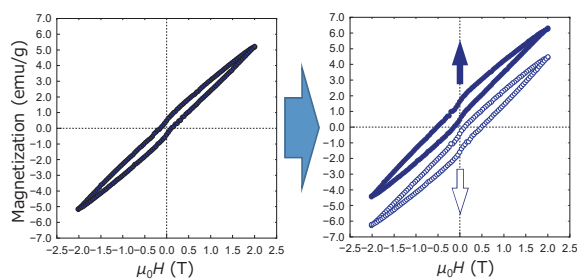


Synthesis in electrical field      Synthesis in magnetic field

- ✓ Succeeded in synthesizing TiO<sub>2</sub> nano-phase, which can be materialized with nano size!
- ✓ Succeeded in tailoring of this phase with different electronic structure by changing applying field !

### Research for Magnetism of Spinel Oxide

- Magnetism of spinel oxide has long research history.
- Recently, this material attracts attention from viewpoint of its complicating spin ordering arisen by the disorder.
- Hysteresis in the magnetization curve is one of the important property for the application of the magnetic materials



- ✓ Our research focusing on the local magnetism in the spinel oxide succeeded in changing the hysteresis curve reversibly and continuously !
- ✓ This material is not a device but a simple oxide !

## Publications

- T. Nakane *et al.*, *Dalton Trans.* **44** (2015) 997-1008.
- S. Ishii, T. Nakane, S. Uchida, M. Yoshida and T. Naka, *J. Asian Ceram. Soc.* **6** (2018) 7-12
- S. Ishii, T. Nakane, T. Furusawa and T. Naka, *Cryst. Res. Technol.* **51** (2016) 324-332.

## Summary

- We can create new materials by developing our processing techniques.
- Bring out local structure and the properties is believed to be effective approach for tailoring new functional materials.

## Research outcome

- Providing information about the relationship between the fabricating process and the physical properties of product
- Creating new functional materials
- Proposing novel processing techniques
- Challenging the discovery of novel physics