

Development of novel electronic materials utilizing light elements

Research Project Outline (From Oct. 2011 to Mar. 2017)

Search for novel electronic properties in metal oxides including **light elements such as N and F** and their device applications.

◎To design novel electronic materials based on first principles calculation and to synthesize them using gas-phase reaction.

◎To applied the synthesized new materials to organic EL and solar cell.

→The materials exploration on a basis of band engineering using light elements would contribute to next-generation energy conversion technology.



Pulsed laser deposition Organic solar cell

Research Results (FY2014)

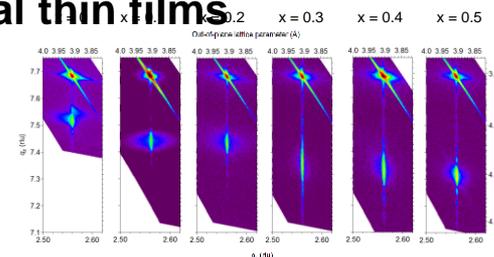
◆ Lattice strain and ferroelectricity in $\text{Ca}_{1-x}\text{Sr}_x\text{TaO}_2\text{N}$ epitaxial thin films

✓ $\text{Ca}_{1-x}\text{Sr}_x\text{TaO}_2\text{N}$ epitaxial thin films were coherently grown on SrTiO_3 substrate by PLD. The film with $x=0.5$ exhibited the c/a ratio of ~ 1.05 .

✓Trans type nitrogen ordering was confirmed by linearly polarized XAS and STEM-EELS measurements.

✓Topotactic oxidation using NaClO could reduce the amount of oxygen vacancies and enhance the ferroelectricity.

Promising photoelectric energy conversion material



Reciprocal space map of $\text{Ca}_{1-x}\text{Sr}_x\text{TaO}_2\text{N}$

J. Appl. Phys., 116, 053505 (2014)

◆ Development of transparent conducting films with controlled optical properties

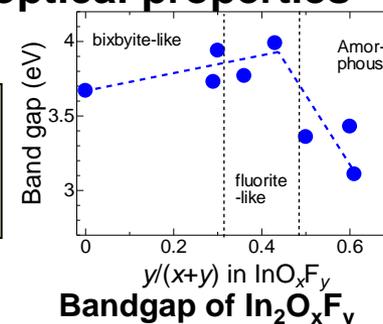
✓The optical properties of InO_xF_y were systematically controlled by the fluorine content x .

✓A novel topotactic fluorination process using PVDF for thin film samples was developed.

✓High mobility of $> 200 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ was achieved in amorphous Zn-O-N .

✓Carriers were successfully introduced into high diffractive index TaON .

Tailored transparent conducting film suitable for organic devices



Thin Solid Films, 559, 96 (2014). *J. Mater. Chem. C*, 2, 5350 (2014).

Bandgap of $\text{In}_2\text{O}_x\text{F}_y$