Synthesis of a tin compound bearing N-alkoxy carboxamide and methyl ligands as a precursor for SnO_2 fabrication via atomic layer deposition

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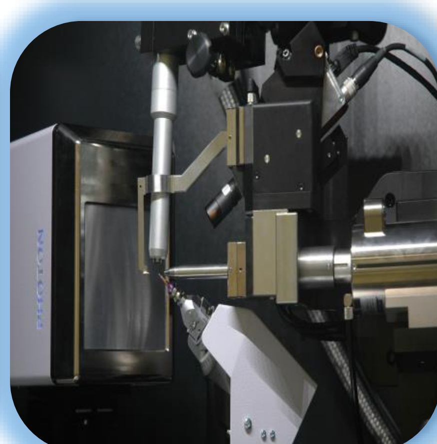
Contents

Overview of Our R&D Team

Development of Core Technologies for Advanced Electronic and Information Materials

Molecular Design ALD/CVD Precursors	Precursors chracterization	Development of deposition process	Applications in Semiconductors



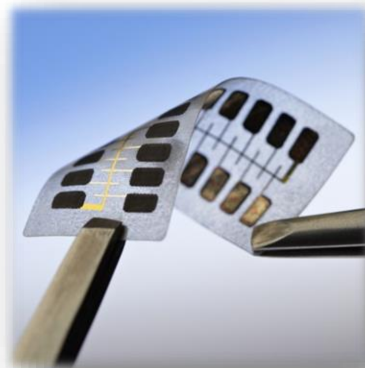
Experiment background

Application of oxide semiconductor

Display

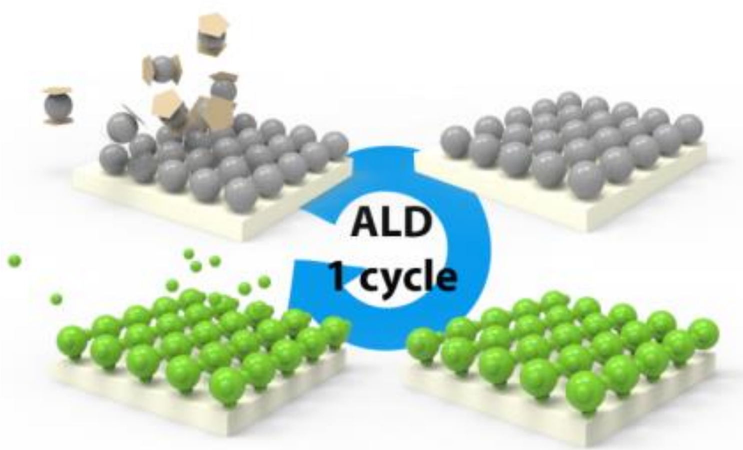
Optoelectronic

Sensor



Battery

Mechanism of atomic layer deposition (ALD)



1. Sequential surface chemical reaction process

- Each precursor supplying sequentially without thermal decomposing
- Forming films by repeating cycles

2. Chemisorption saturation process

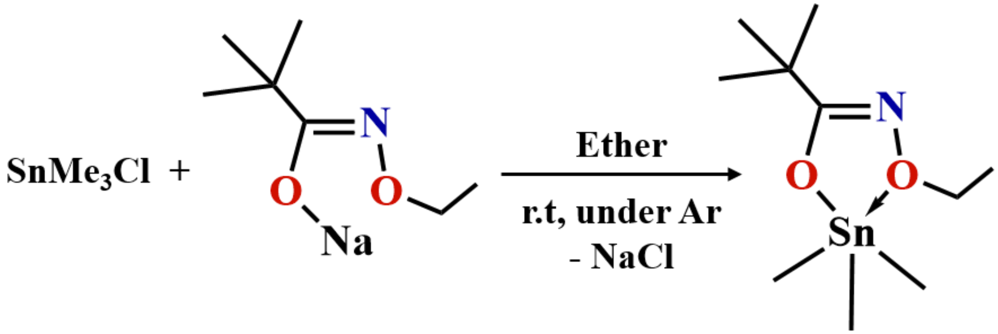
- Precursor vapor distributing on surface and saturated by self-limited reaction
- Surface reaction and removing physisorbed precursor by inert gas

- **Exact thickness control in nano-scale**
- **Excellent large area uniformity**
- **Superior step coverage contrast to PVD and CVD**

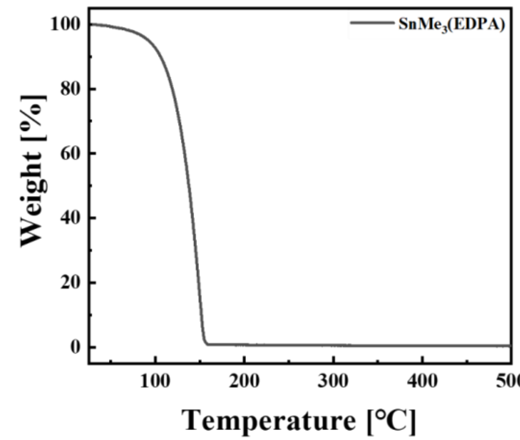
Result

Precursor (Synthesis and characteristic)

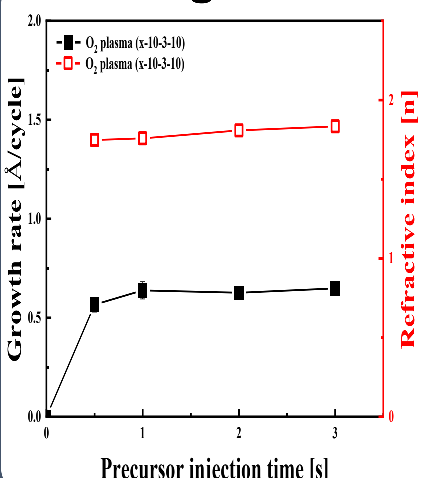
- **Synthesis**

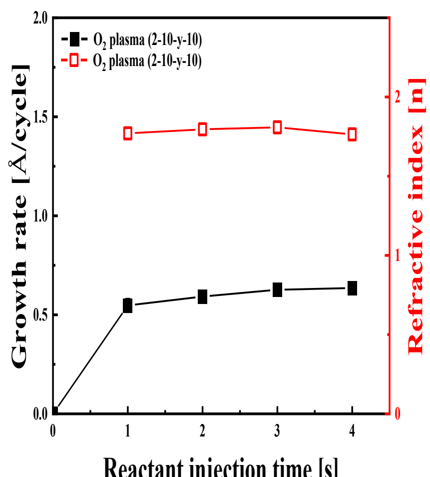


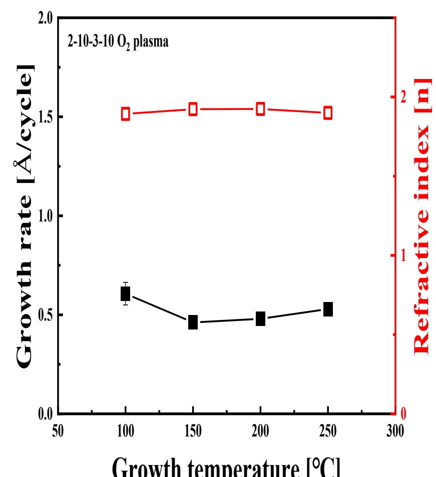
- **TGA**



ALD growth behavior



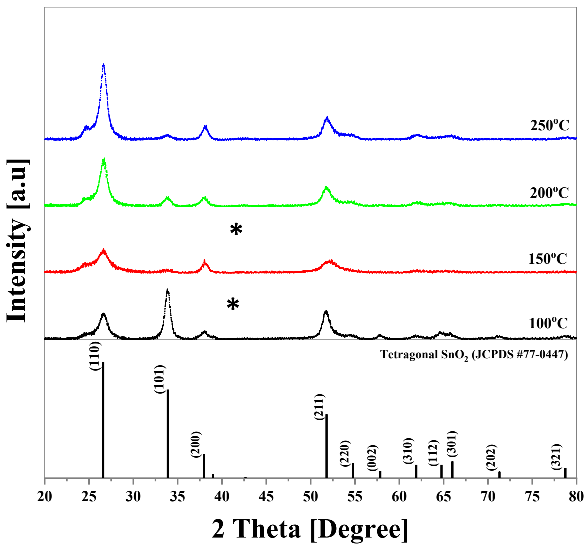


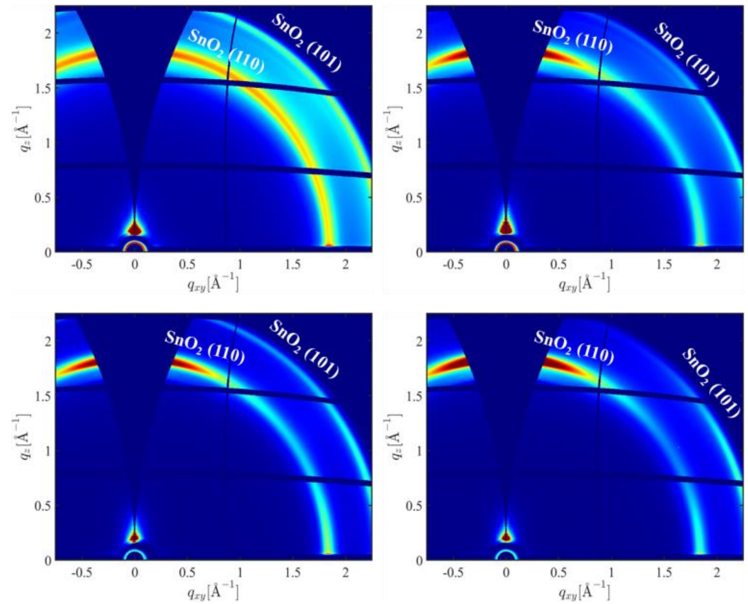


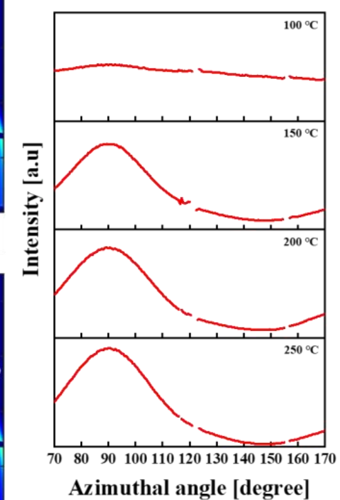
- SnO_2 film exhibited typical self-limited surface reaction characteristics
- ALD window in the growth temperature range between 100 – 250 ℃

Result

Structural analyses





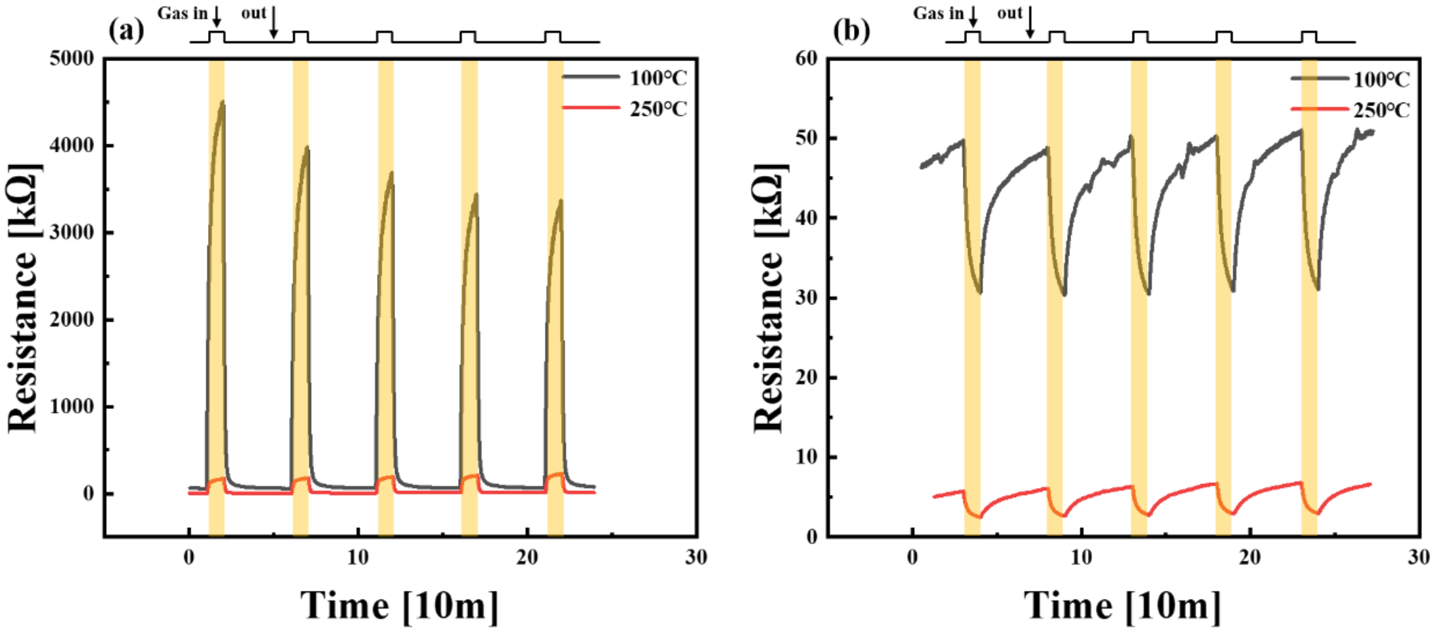


- At 100 – 250 °C, tetragonal SnO_2 formed
- **Temperature increased, the intensity of (110) plane increased**

- At all deposition temperatures, the X-ray reflections are observed at values of 1.875 and 2.376 $Å^{-1}$, which indicate the (110) and (101) planes of the tetragonal SnO_2
- (110) plane of the SnO_2 thin films deposited at 150−250 °C indicate a preferential growth to the c-axis, whereas the (101) plane exhibits a random orientation

Result

Gas sensor application



Material used	Deposition	Gas	Temperature (℃)	Response (%)
Thin film	sprayed	NO_2	350	60(500 ppm)
Nanobelts	Carbothermal reduction	NO_2	200	45(50 ppm)
Thin film	Sol gel	NO_2	Not detailed	25(500 ppm)
Thin film	CBD	NO_2	Not detailed	44(100 ppm)
Nanotubes	electrospinning	NH_3	Room temp	2.48(100 ppm)
Thin film	sputtering	NH_3	230	25.7(450 ppm)
Deposited at 100 °C	**ALD**	**NO_2**	**300**	**6000(100 ppm)**
Deposited at 100 °C	ALD	NH_3	300	40(100 ppm)
Deposited at 250 °C	ALD	NO_2	300	2500(100 ppm)
Deposited at 250 °C	ALD	NH_3	300	36(100 ppm)

Conclusion

- We successfully deposited tin oxide by atomic layer deposition (ALD) using a novel precursor and O_2 plasma.

- The properties of films through various analysis methods. As a result, SnO_2 films deposited at low temperatures have significant potential as high-performance gas sensor materials.