ECR薄膜の電気特性

Electrical Properties of ECR Films
Metal Mode and Oxide Mode

On ECR plasma deposition, two deposition modes (metal mode and oxide mode) clearly appear when oxides are deposited with a metal target.

**Characteristics of metal-mode deposition**
- Metallic surface of the target
- Large sputtering yield (Large deposition rate)
- Sufficient oxidation on the sample surface by the ECR plasma stream
- High-quality oxide film
- Small oxidation for film/substrate interface
ECR-SiO$_2$ 膜の成膜特性とC-V特性
Deposition Characteristics and C-V Curves of ECR-SiO$_2$ Films

C-V curves

![Graph showing deposition rate and refractive index vs. oxygen flow rate](image)

- Ar Flow Rate: 30 SCCM
- Microwave Power: 500 W
- RF Power: 500 W

Oxygen Flow Rate (SCCM) vs. Deposition Rate (nm/min) and Refractive Index

(SCCM: Standard CC/min, standard: 0℃, 1 atm.)
ECR–SiO$_2$ 膜の絶縁抵抗率

Resistivity of ECR–SiO$_2$ Film
ECR-Al$_2$O$_3$膜の絶縁抵抗率
Resistivity of ECR-Al$_2$O$_3$ Film

Metal-mode film

Oxide-mode film

Target: Al
Ar/O$_2$: 30/3 SCCM
Microwave power: 500 W
RF power: 500 W
Capacitance Characteristics of Ultra-Thin ECR-Al$_2$O$_3$ Films

XTEM image of metal-mode Al$_2$O$_3$ film

TiN/Al$_2$O$_3$/p-Si/Al
1MHz

$K=10$

Al target
Ar/O$_2$ (Metal-mode)

Anneal: 550°Cx2min (Vac) 400°Cx30min (H$_2$)
**Capacitance Characteristics of Ultra-Thin ECR-HfO₂ Films**

**Graph:**
- **X-axis:** HfO₂ physical thickness (nm)
- **Y-axis:** Equivalent Oxide Thickness (nm)
- **Graph Title:** $K: \sim 30$

**Image:**
- Silicon (100) substrate
- HfO₂ (4nm)
- Al/TiN/HfO₂/p-Si/Al
- Aluminium (Al) layer
ECR-ITO・IZO薄膜の抵抗率

Resistivity of ECR-ITO・IZO Films

Deposition without substrate heating
Resistivity of ECR-ITO Films

Resistivity less than $2 \times 10^{-4} \, \Omega \text{cm}$ is obtained with substrate heating during deposition.