Spray Coated Thin Film Barriers for Improved Environmental Durability of Transistors

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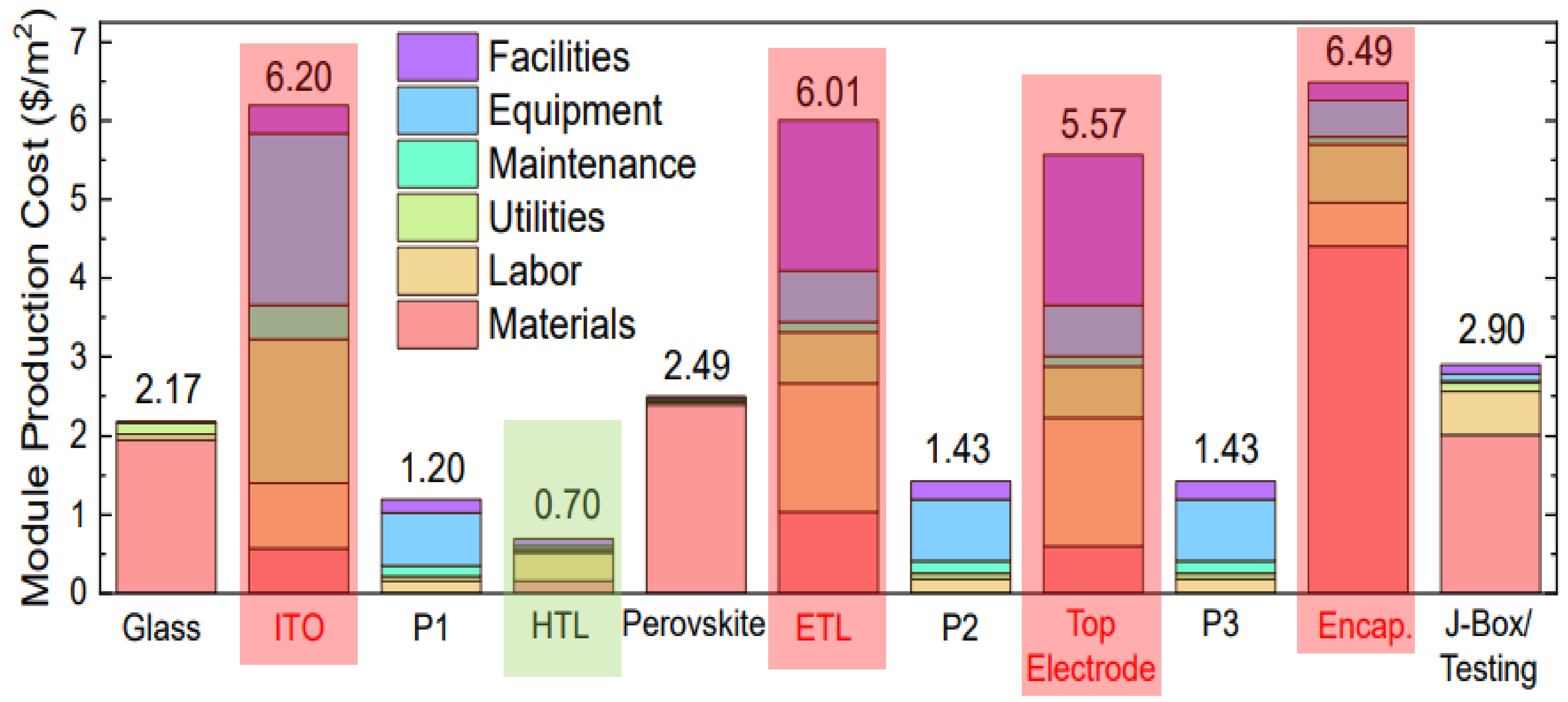
Introduction



Red: Thin film applications completed under vacuum → $$$

Green: Open-air sprayed films → $

What is a cost-effective technique to prevent water vapor damage to transistors?

- Aluminum nitrate nonahydrate $Al(NO_3)_3$ to form an alumina-based thin-film applied with an **open-air spray coater**. The goal is to ensure that transistors exposed to water vapor retain their efficiency rates.

Transistor Schematic

Source – Drain – Measure conductance across the transistor

Aluminum Oxide – Barrier coating → Water resistant

ITO- Indium Tin Oxide

Conductivity rates of bare NiO_x, ITO ~ 50 ohms

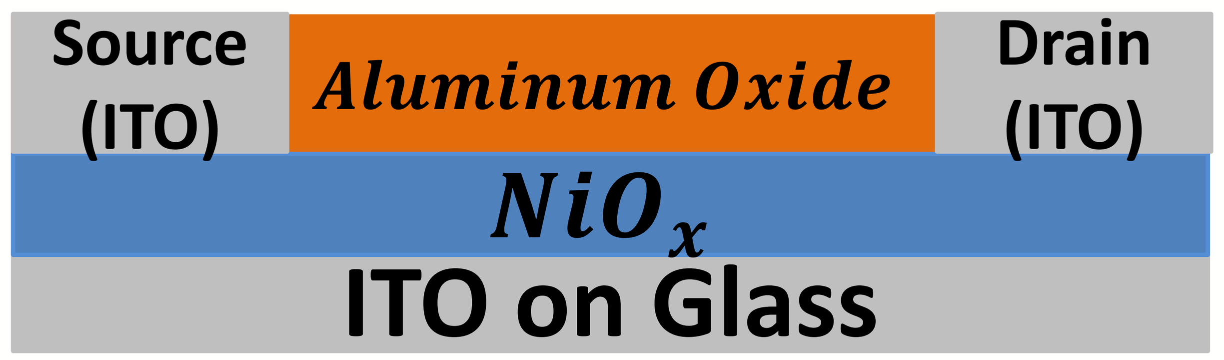
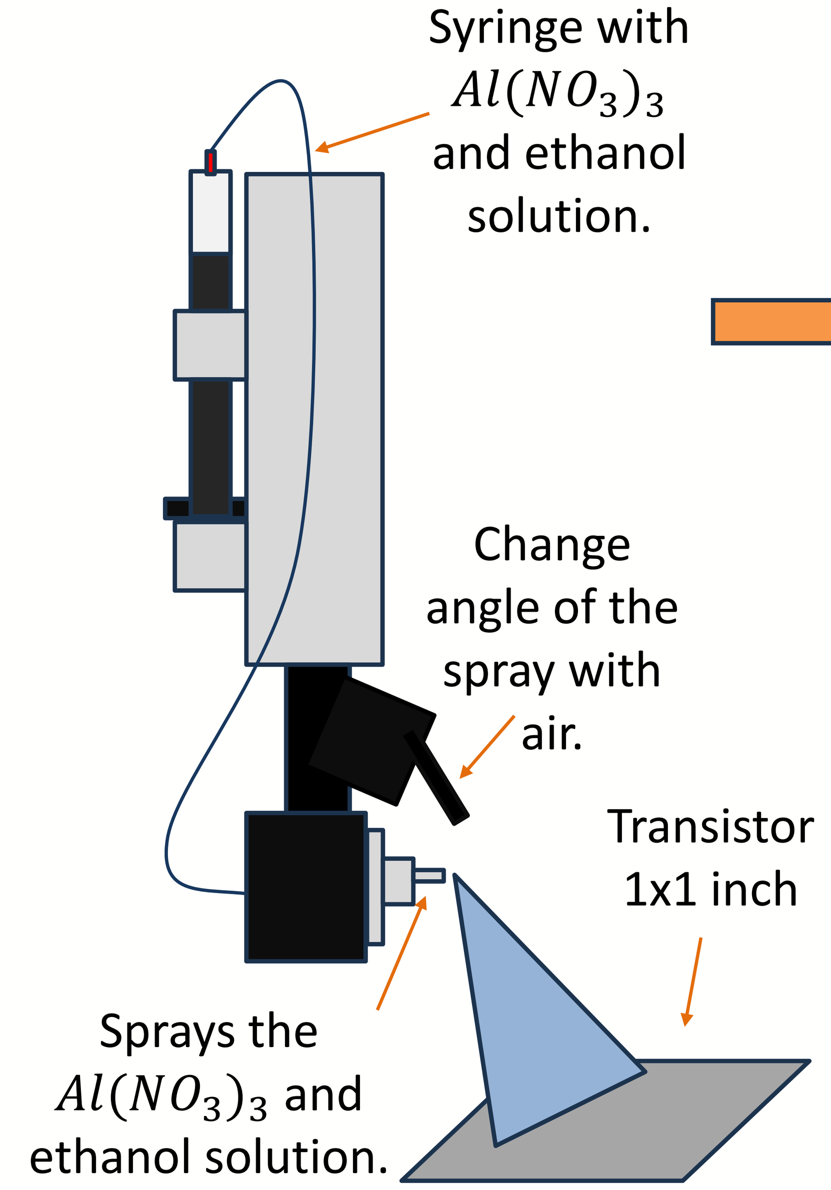


Figure 1: Schematic of transistor with resistive film

Methodology

Open-air spray coater



$Al(NO_3)_3$: 100 g → $65.70

0.37 g $Al(NO_3)_3$/10 mL ethanol

Annealing

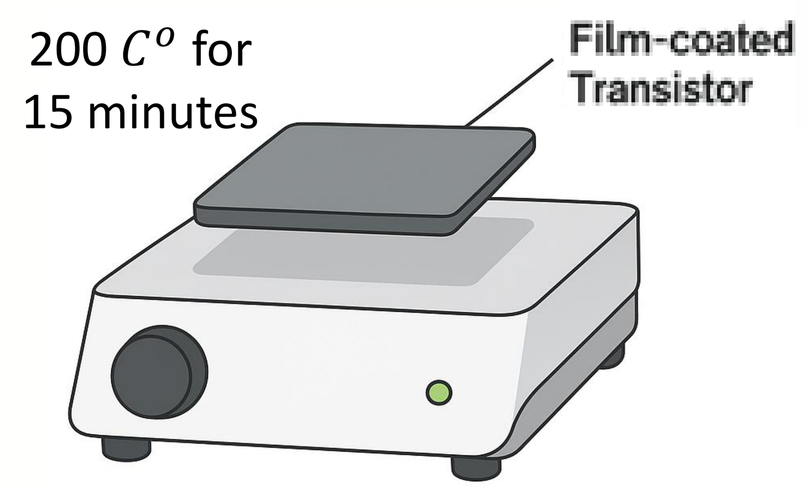


Figure 3: Hot plate annealing alumina films

Densifies films → decreases film defects (pinholes)

$Al(NO_3)_3$ → oxidized alumina film ~300 nm → **resists water vapor**

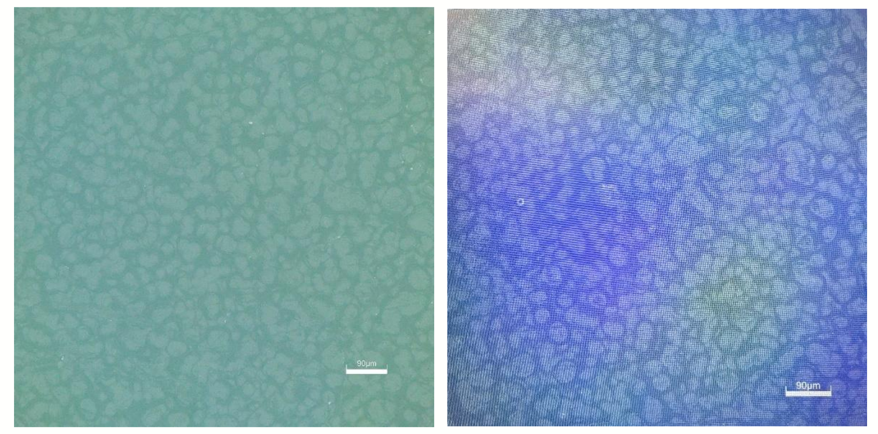
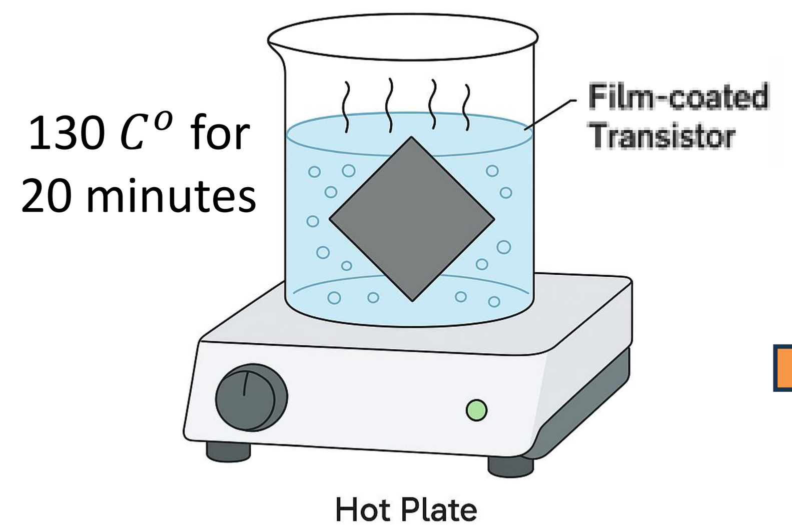


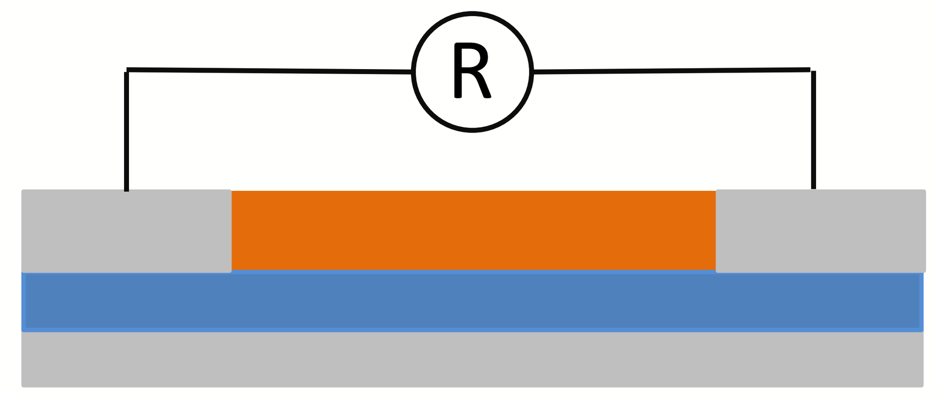
Figure 2: Left- ITO, NiOx on glass microscopy image Right- ITO on glass, NiOx coated with $Al(NO_3)_3$

Aging



Assess alumina film's protection against transistor degradation

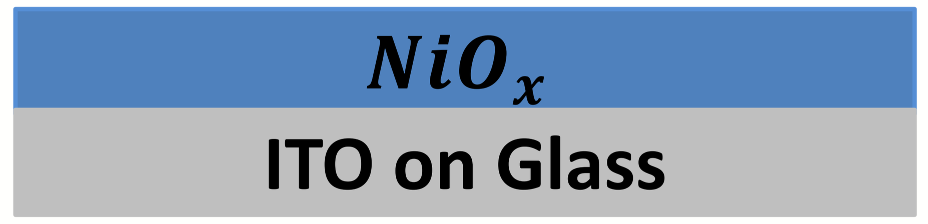
Conduction Testing



Measure conductivity rates of samples before and after aging conditions

Current Challenges

Aging of control variable



- **Goal:** Degrade conduction rates of two-layer transistor without a protective film.

Past Testing

- Boil in water 140 mins → no degradation
- Soak in room 20 C^o water for ~12 hours → no degradation

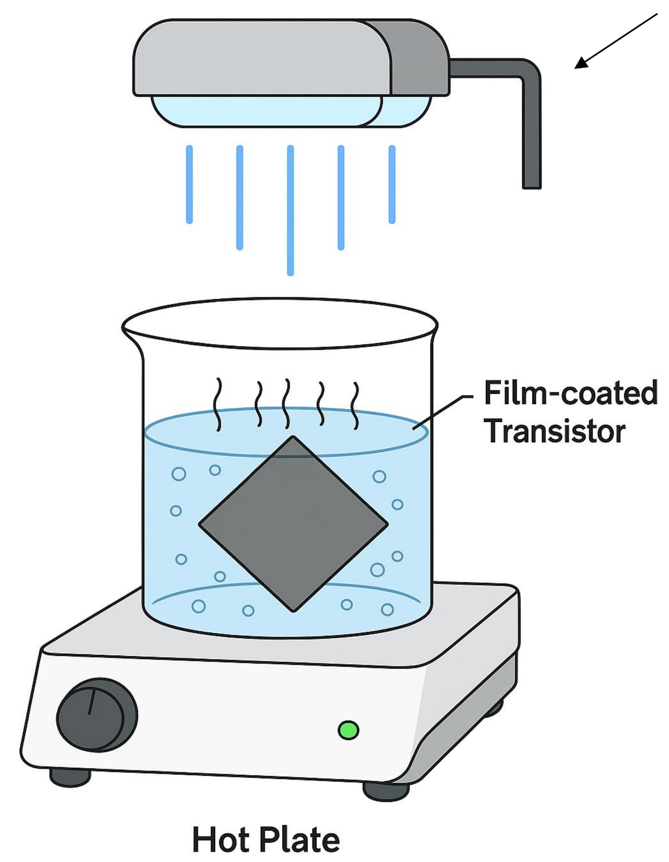
Future Testing

- Expose samples to UVA and boiling water conditions at the same time

Future Work

- Measure the conductivity rates before and after UVA aging conditions.

Aging Thin Film Coated Surface



Environmental Conditions: exposure to UVA (sunlight) and humidity

UV exposure:
hole trap generation → charges trapped in the oxide layer → degradation

Humidity:
water vapor enters through pinholes → degradation

FURI

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