

Diffusion Barrier Properties of ALD TiSiN Films

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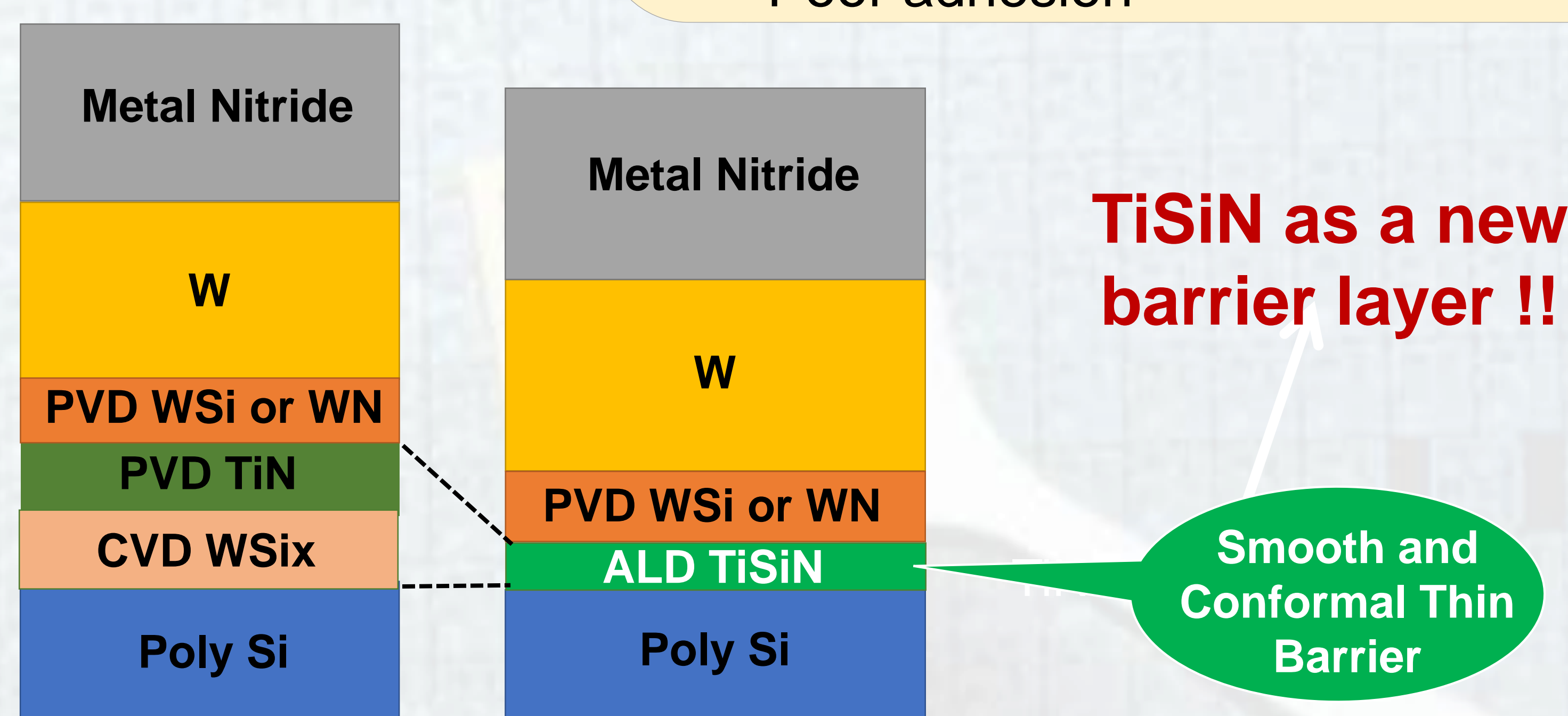
1. Introduction

Requirements

- Barrier property
- Conformality for ultra-thin films
- Good adhesion

Issues with Thin TiN Barrier

- Poor continuity < 25 Å and rough poly-crystalline film
 - Higher resistance
 - Poor diffusion barrier
 - Poor adhesion

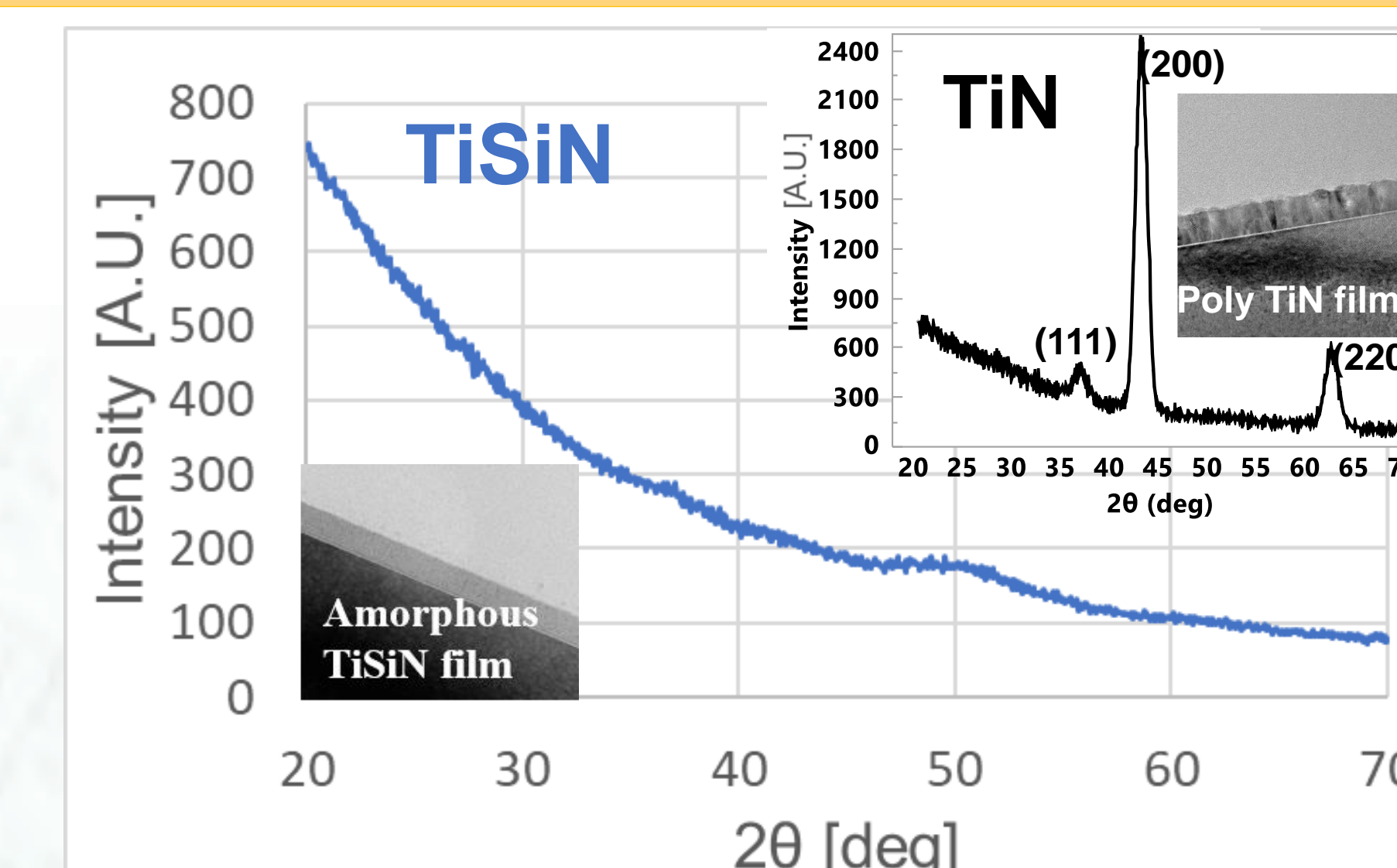


3. ALD TiSiN Film Properties

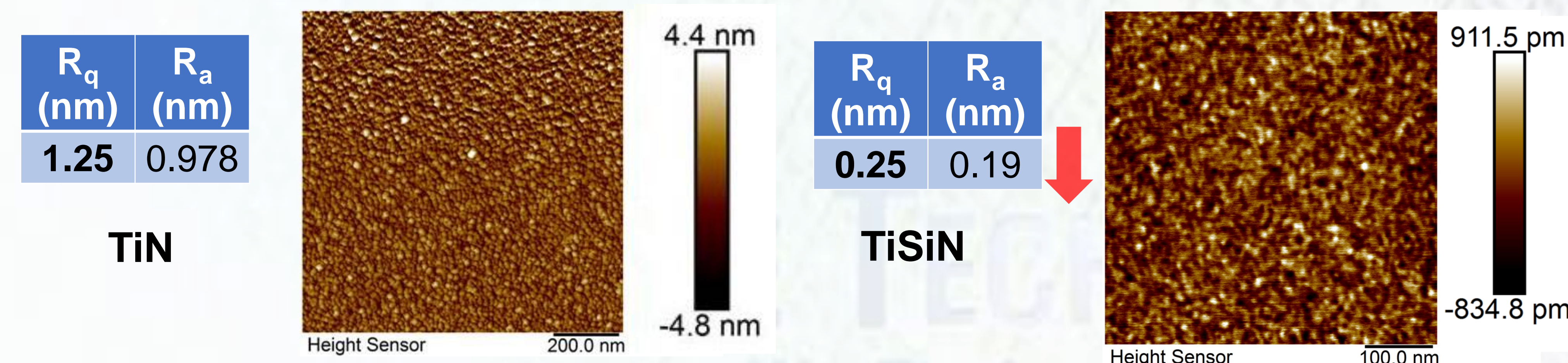
(a) TiSiN Film Process Parameters

- Si precursor: Chlorosilanes
- Ti precursor: $TiCl_4$ and others
- N co-reactant: NH_3 and others
- Susceptor temperature: 300-650 °C
- Pressure : < 10 Torr

(b) GIXRD of Amorphous TiSiN



(c) Good Surface Morphology



2. TiSiN Deposition in QXP ALD System



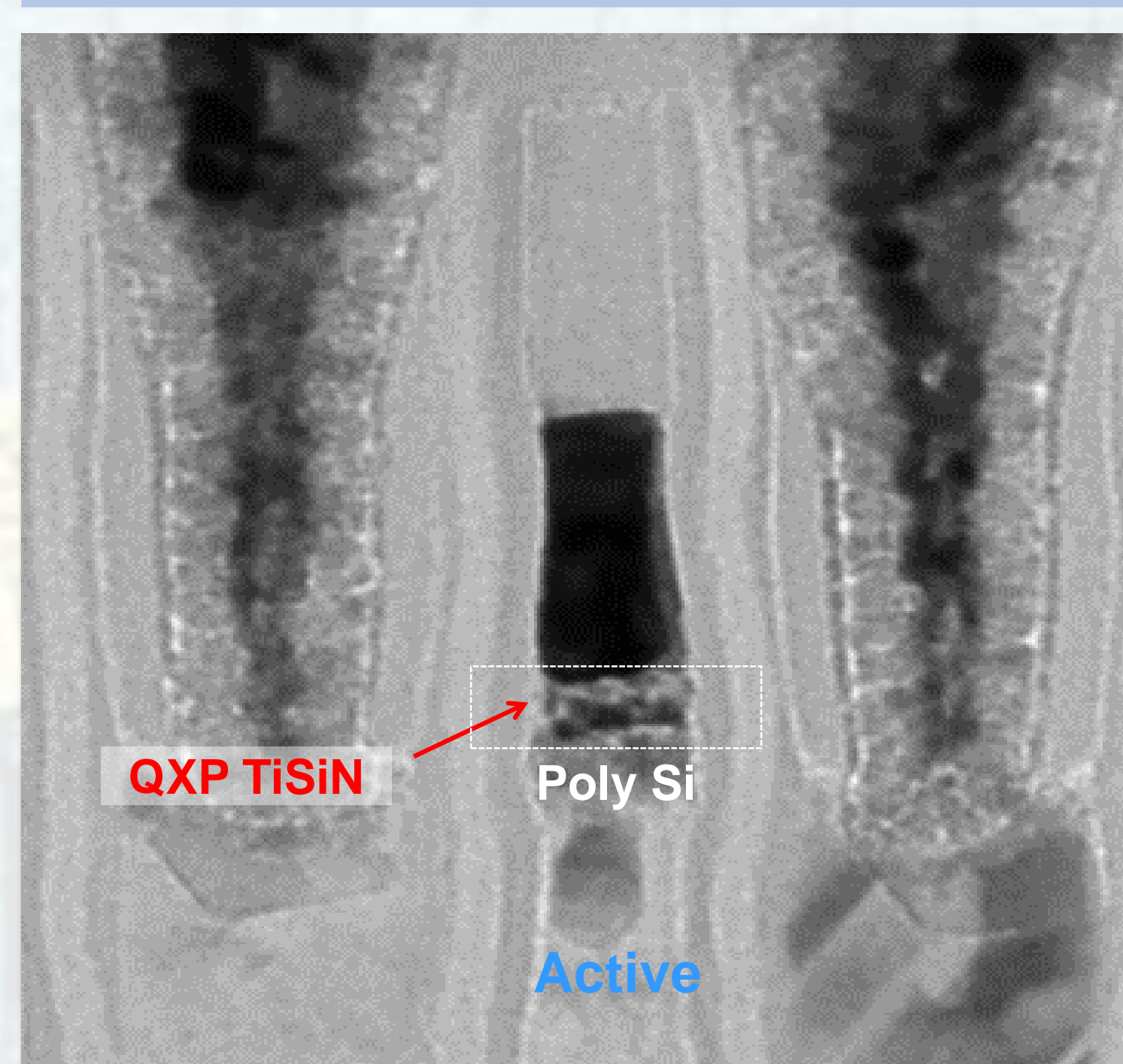
Isolated Four Stations ALD

QXP 300mm Metal ALD Tool

Production Proven Platform

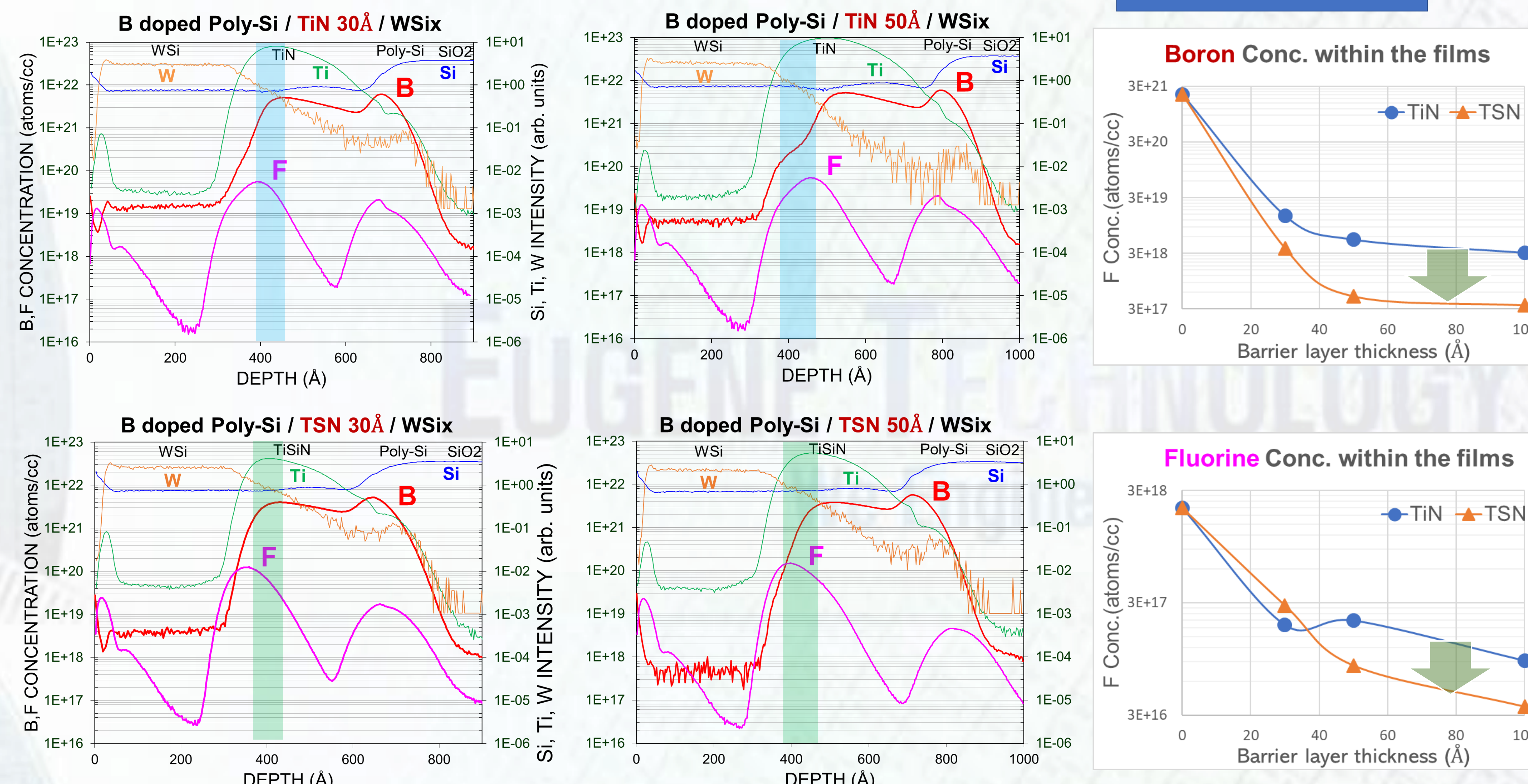
- Physically isolated multi-wafer (4 stations per Process Module) processing
- Small volume; confined space ensuring short ALD cycle time
- High temperature processing capability (> 630 °C)
- Excellent uniformity
- Reliable in HVM

Application/Technology



Source : Chipworks, 2015

4. Diffusion Barrier Studies



- Test stacks are Si/ThOx/B doped Poly-Si/TiSiN or TiN barrier/WSix
- Eugenus ALD TiSiN shows better diffusion-barrier properties than TiN

5. Summary

- Eugenus TiSiN ALD film shortens metal stack height; reduction in parasitic capacitance
- Excellent diffusion barrier property of Eugenus ALD TiSiN film with good conformality is becoming an essential component for successful fabrication semiconductor devices

(Please refer Invited talk "AA3-TuA11" and poster "AA2-TuP17")