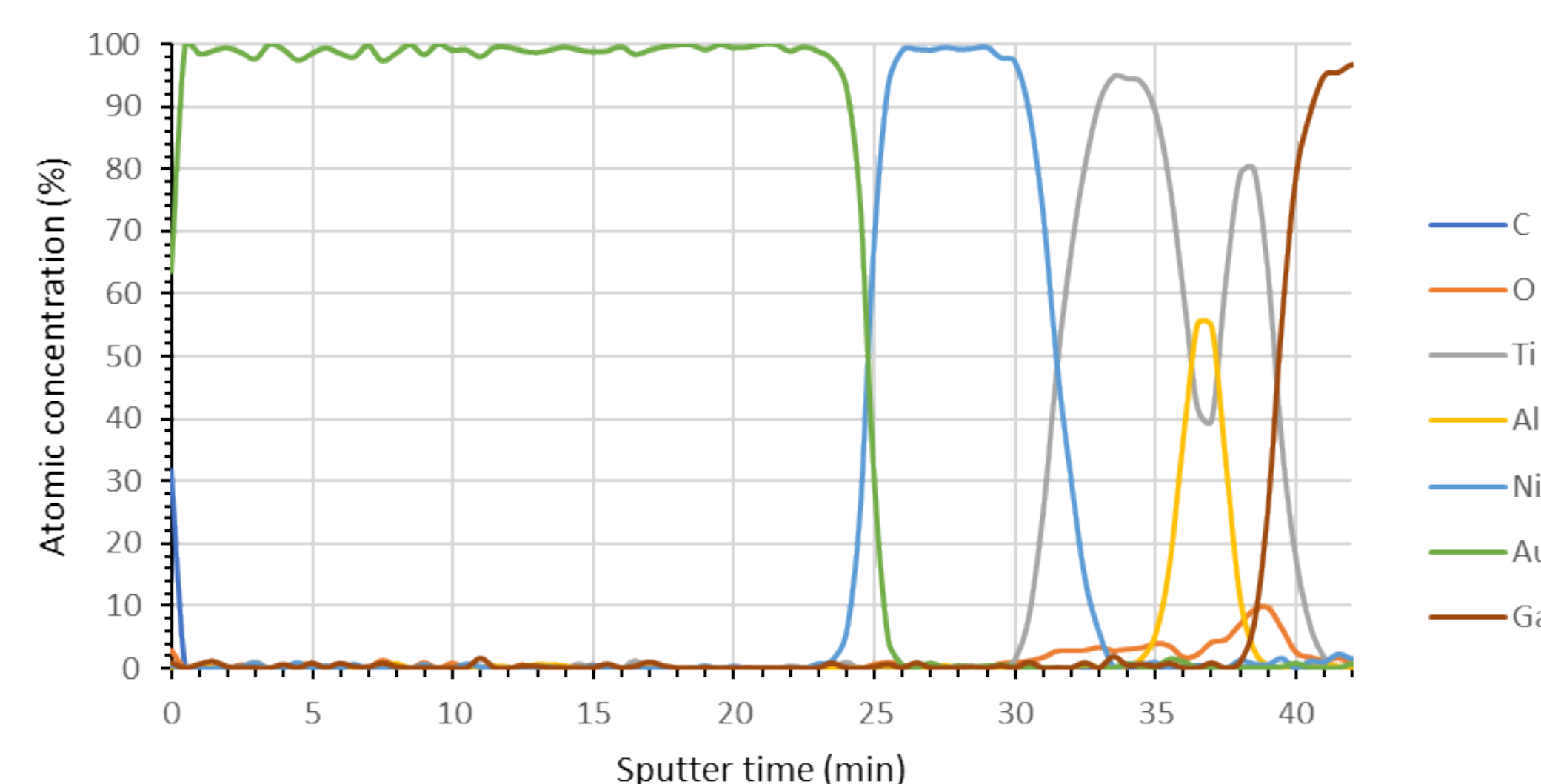


Al-thickness dependence of N-face n-type GaN



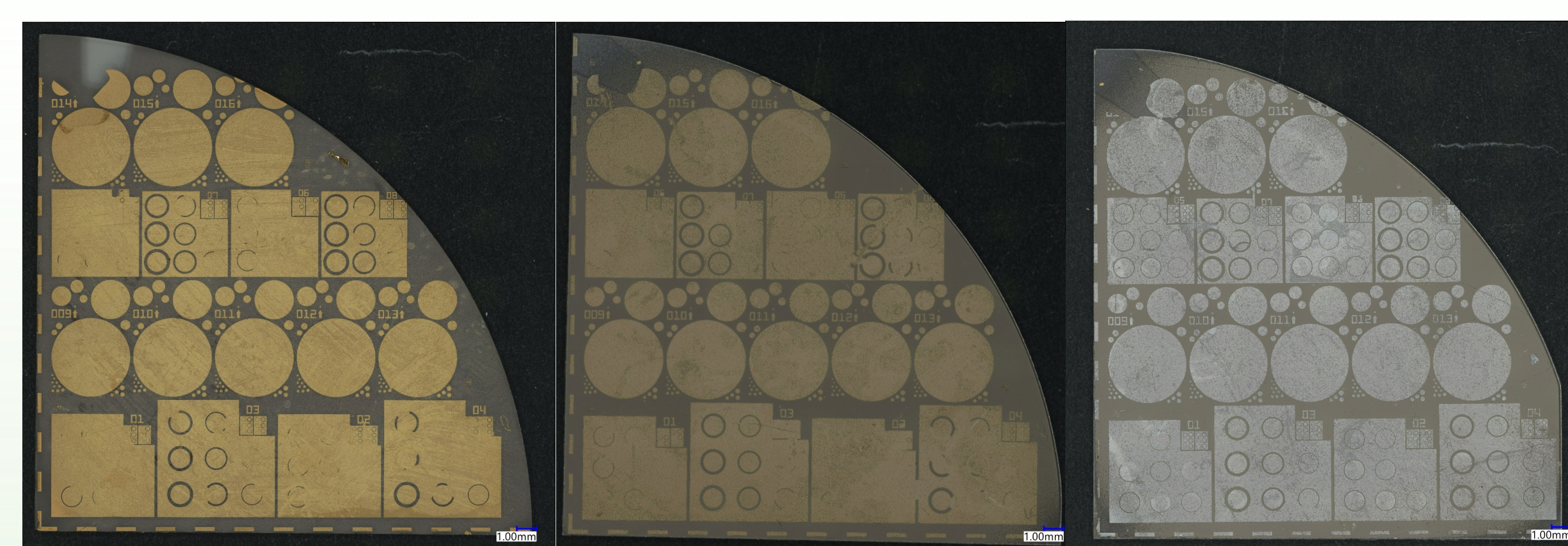
Problem Statement

- The impact of various thicknesses of Al in a Ti/Al/Ti/Ni/Au N-face GaN metal stack are explored.
- N-face GaN surfaces are highly reactive and require careful fabrication control
- Standard CTLM characterization methods should be replaced by the Cox and Strack characterization method for large substrates with no epi-layers

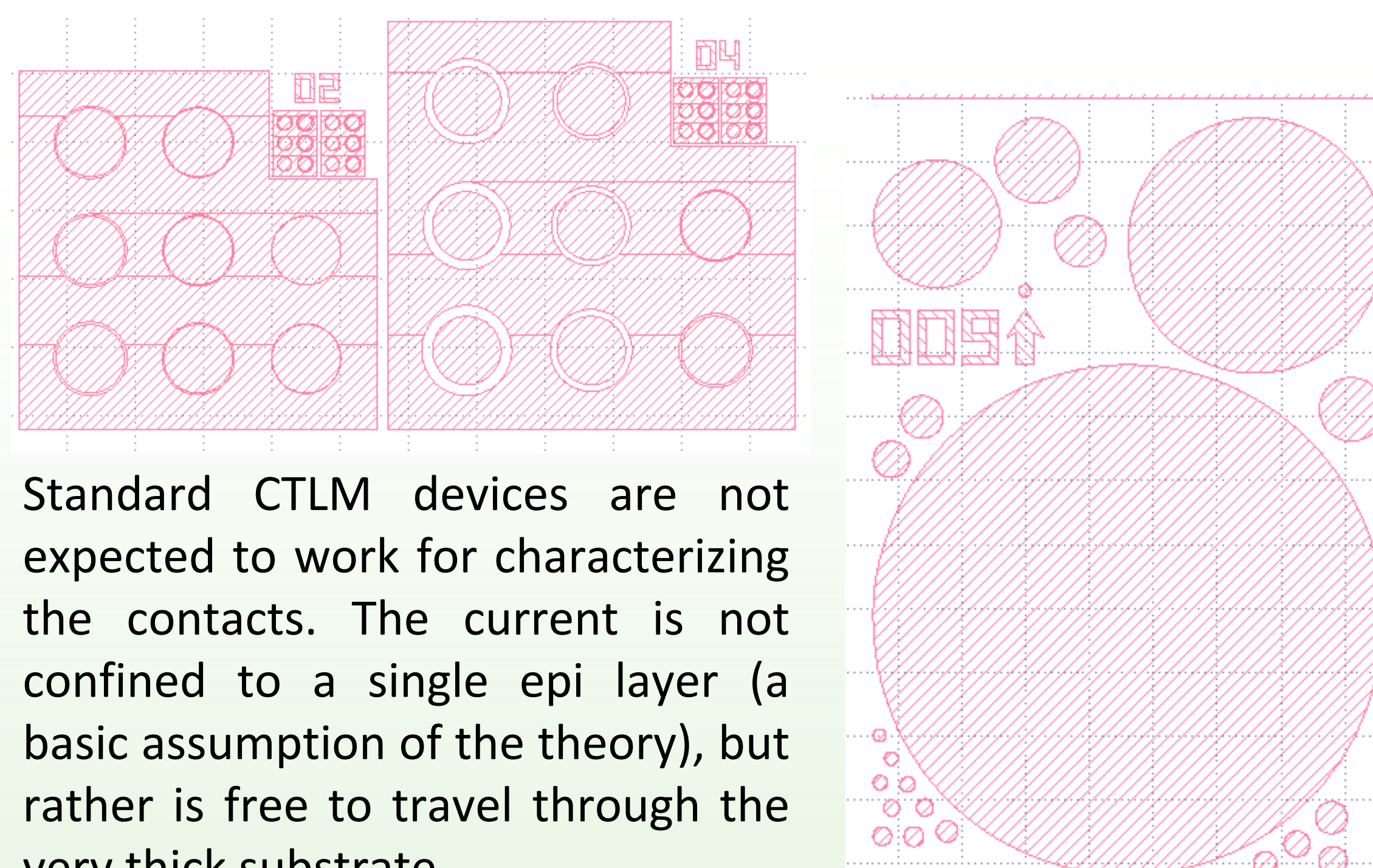


Top: Auger depth profile of the metal stack of sample D.

Left: Metal stack for this study.



10 nm Al 60 nm Al 200 nm Al
Device appearance after the 500C anneal.

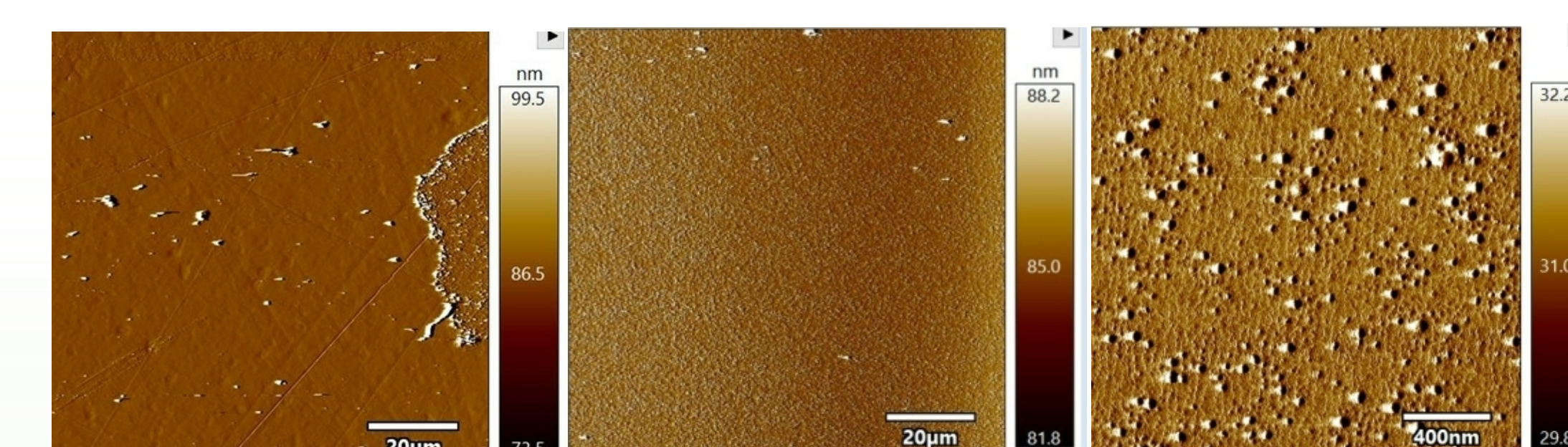
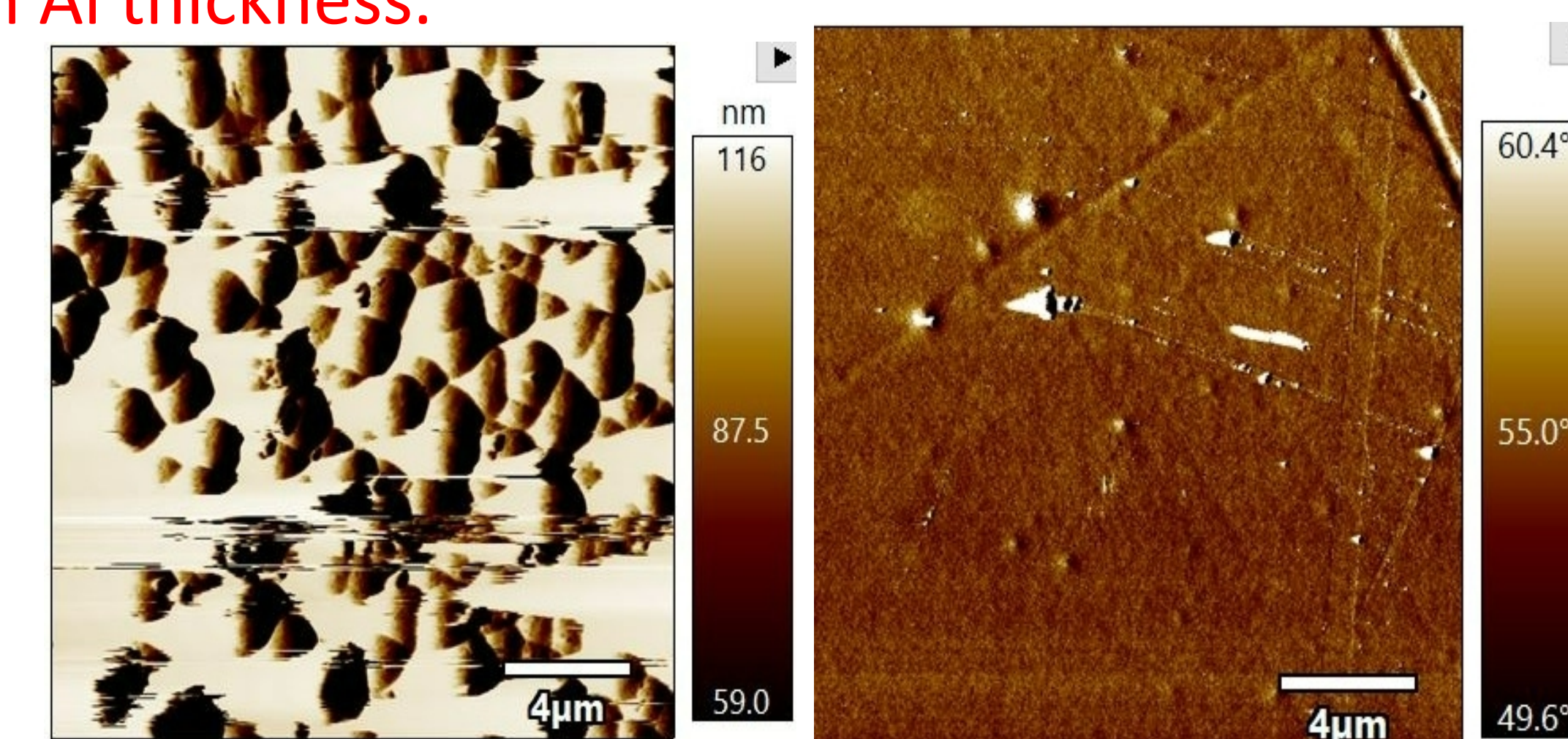


Standard CTLM devices are not expected to work for characterizing the contacts. The current is not confined to a single epi layer (a basic assumption of the theory), but rather is free to travel through the very thick substrate.

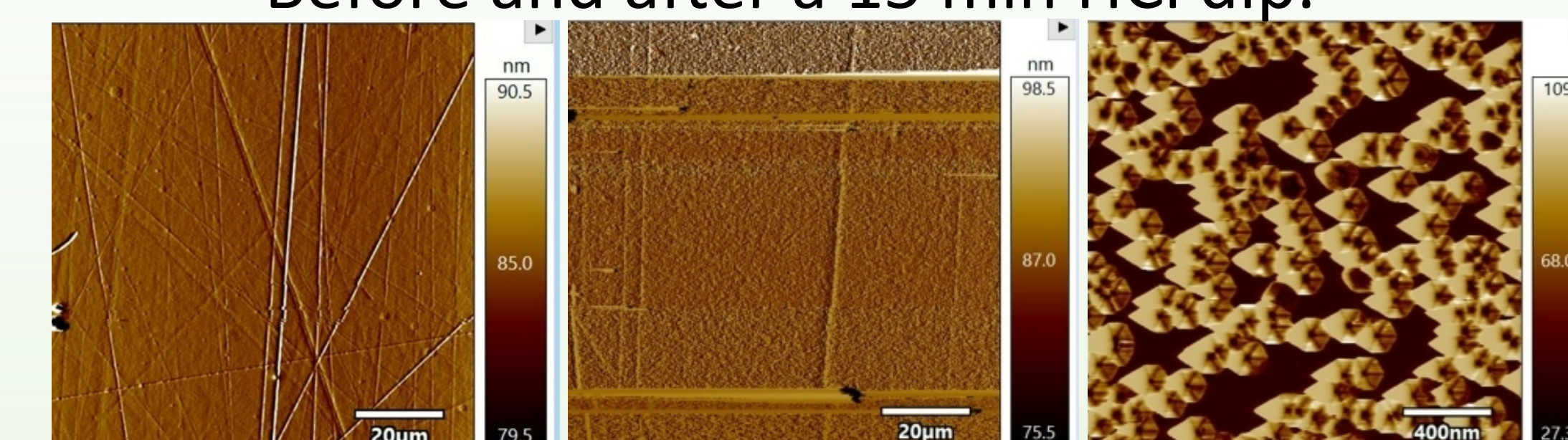
Cox and Strack (1960) introduced a way to probe for contact resistance using circles of various diameter. This method works for thick substrates. The Ga-face is blanket deposited with the same metal stack as the 300 nm Al set. Top and bottom metals are annealed at the same temperature.

Results

- In the initial study (samples A, B, and C) were fabricated. Only sample C was found to be ohmic..
- Later experiments (samples D, E, and F) from three different wafers, with the same 10 nm Al metal stack failed to achieve the same results as sample C.
- There was only one other significant difference between samples A, B, and C. This was the difference in the GaICP etch after lapping and polishing.
 - Sample C used an etch sequence that resulted in a rough surface with a AFM surface roughness value of ~250 nm rms. (shown below on the left)
 - Sample A, B, D, E, and F used an etch sequence that resulted in a smooth surface with a AFM surface roughness value of ~1 nm rms. (shown below on the right)
- Surface morphology appears to be the primary factor in achieving ohmic behavior when compared to variations in Al thickness.



Before and after a 15 min HCl dip.



Before and after a 15 min MIF300 dip.