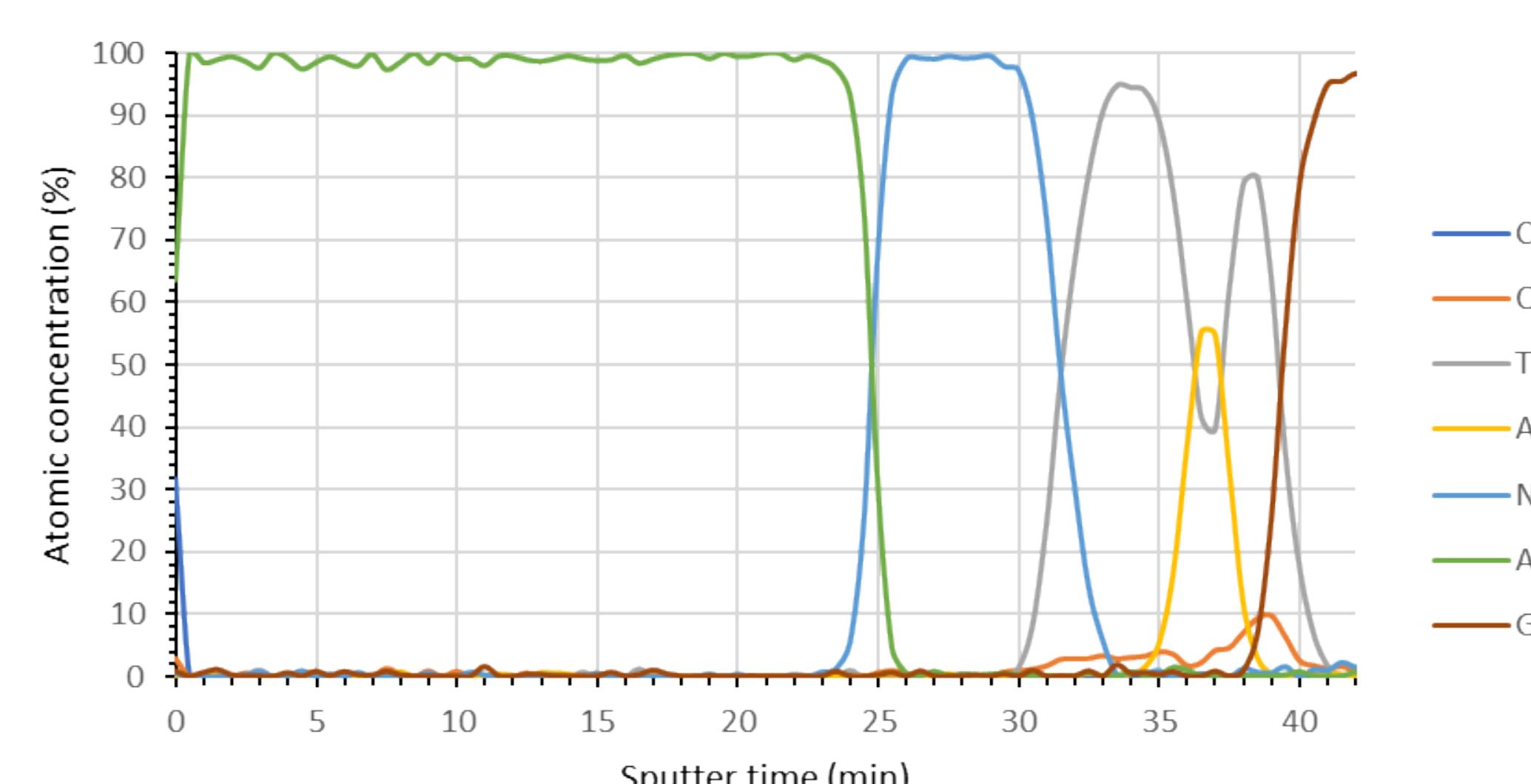
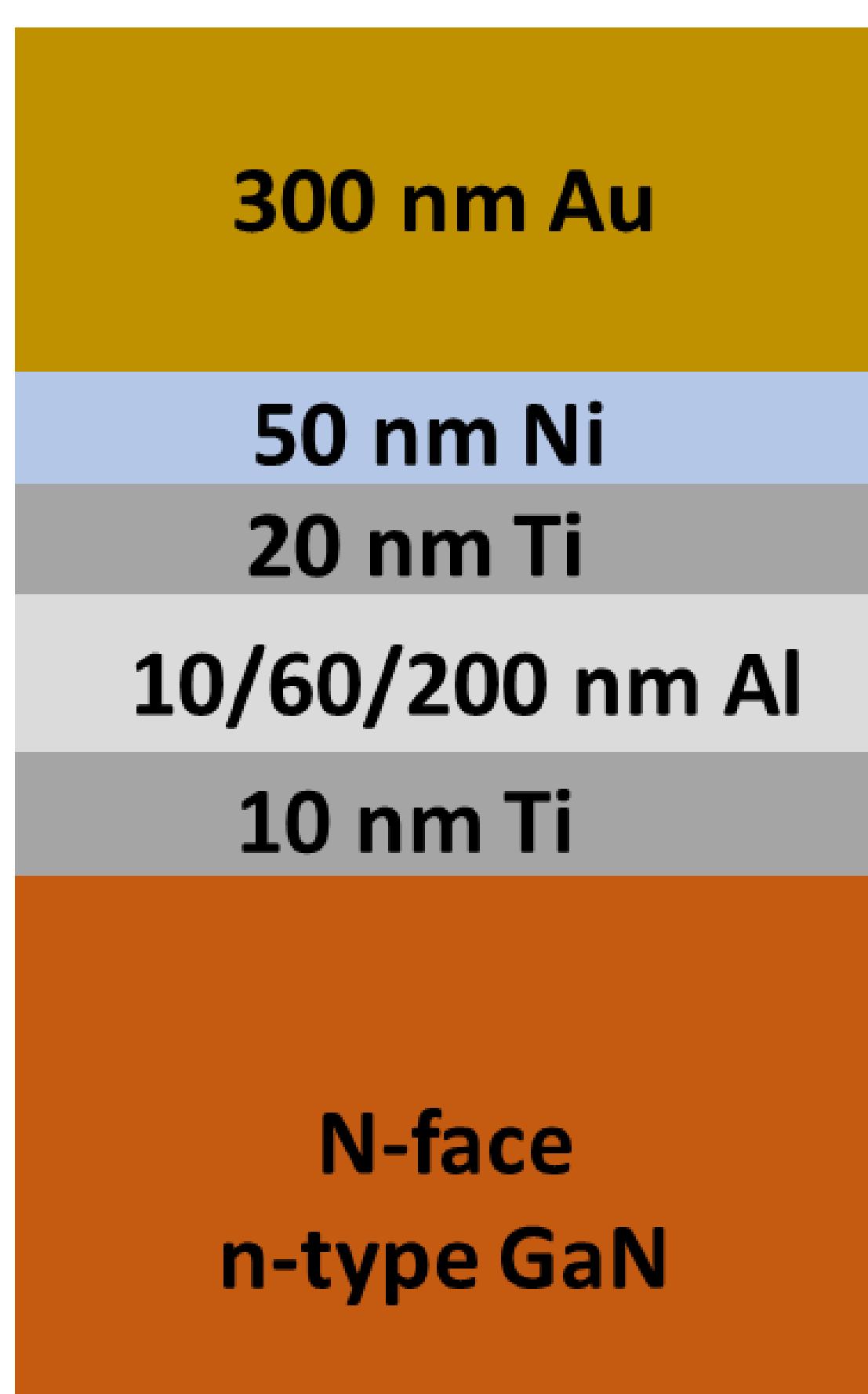


Al-thickness dependence of N-face n-type GaN

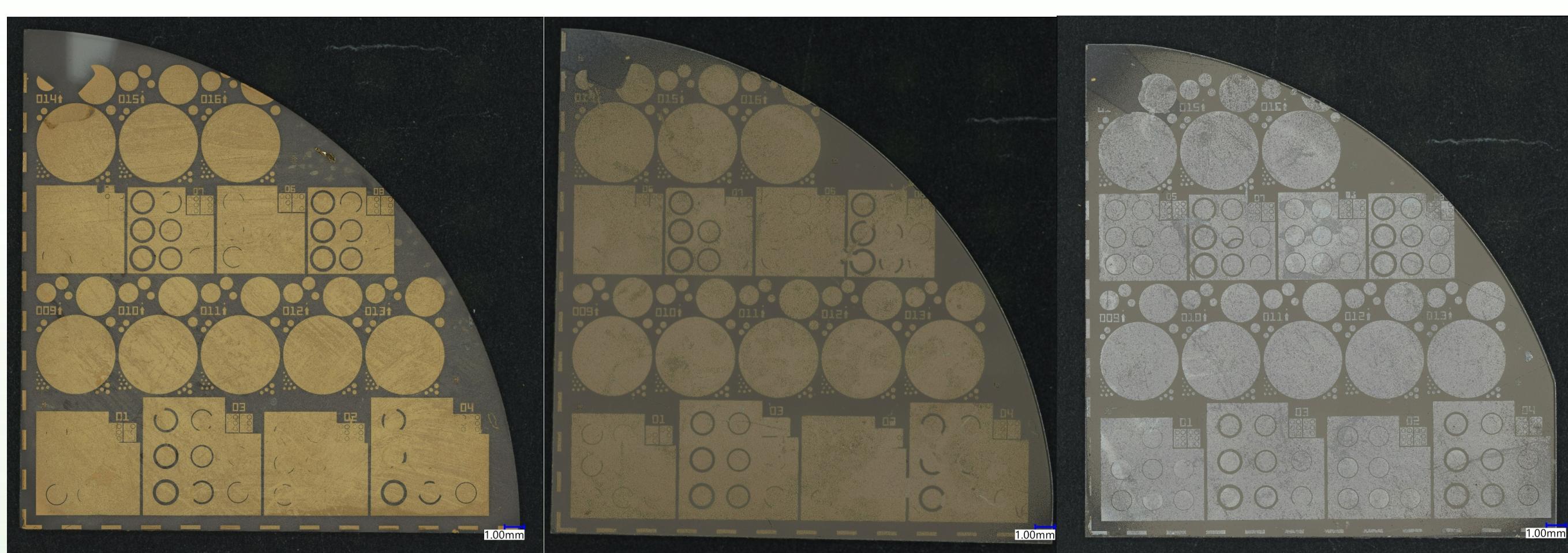
Problem Statement

- 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

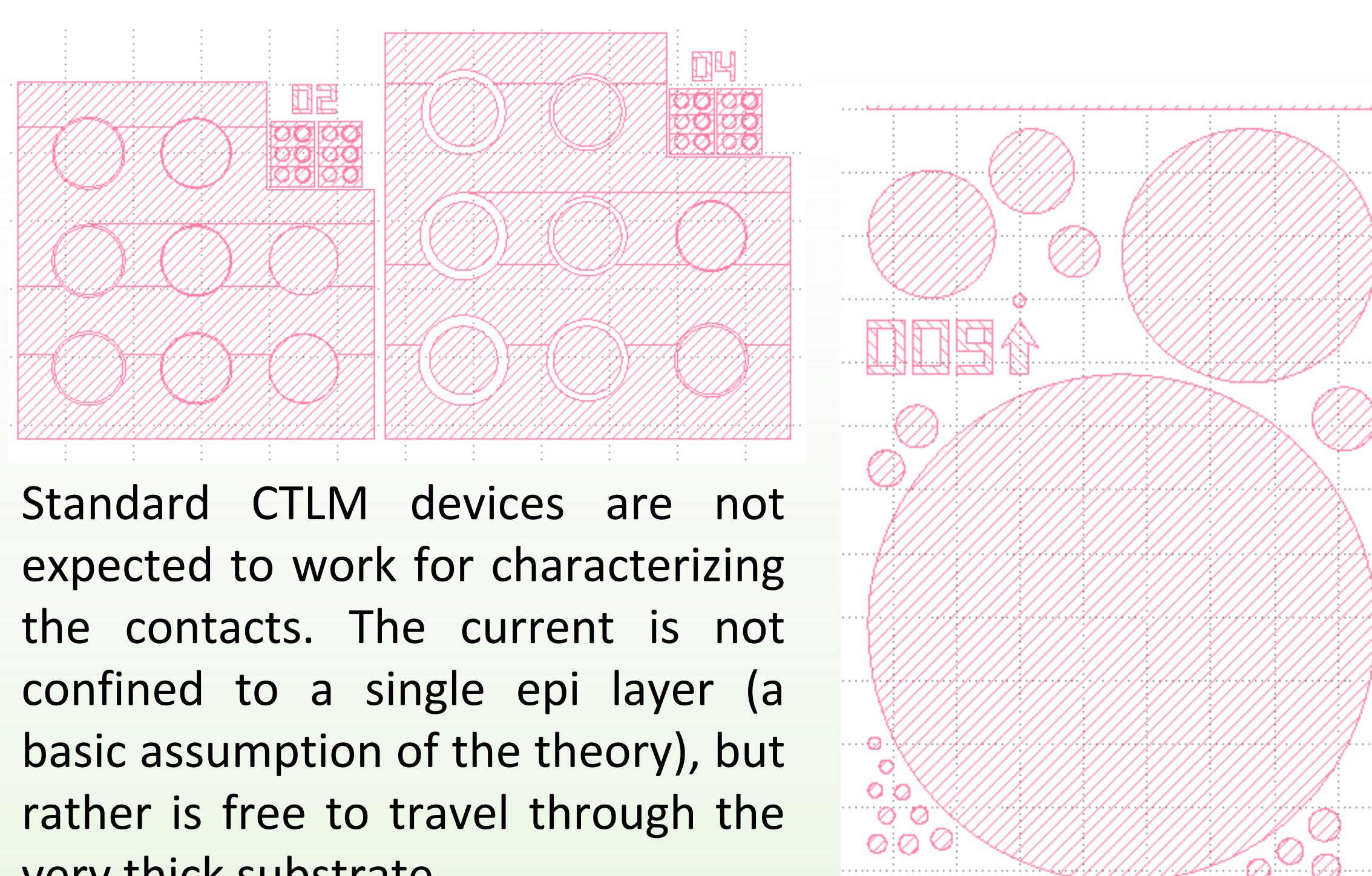


Top: Auger depth profile of the metal stack of sample D.

Left: Metal stack for this study.

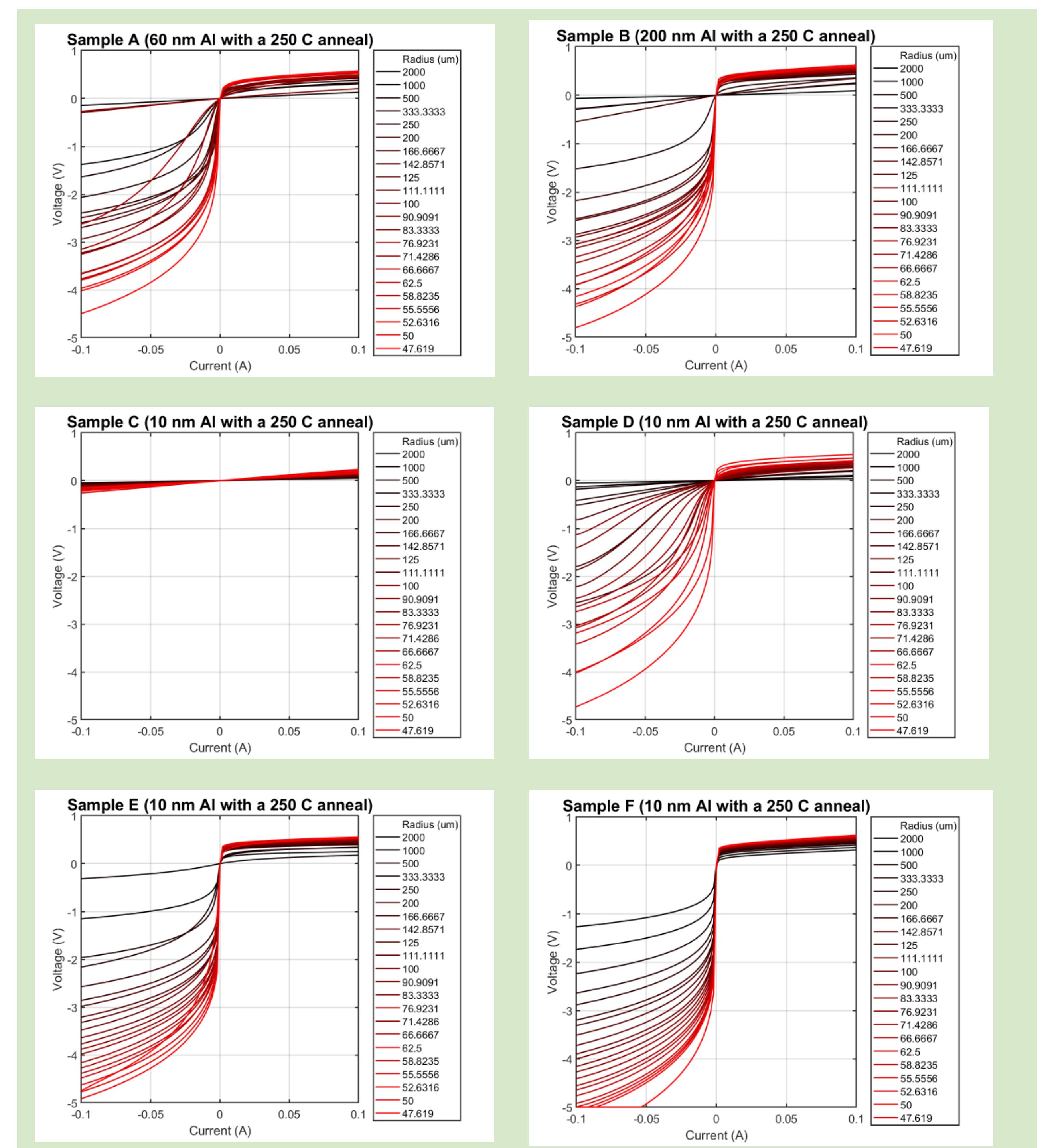


Device appearance after the 500C anneal.



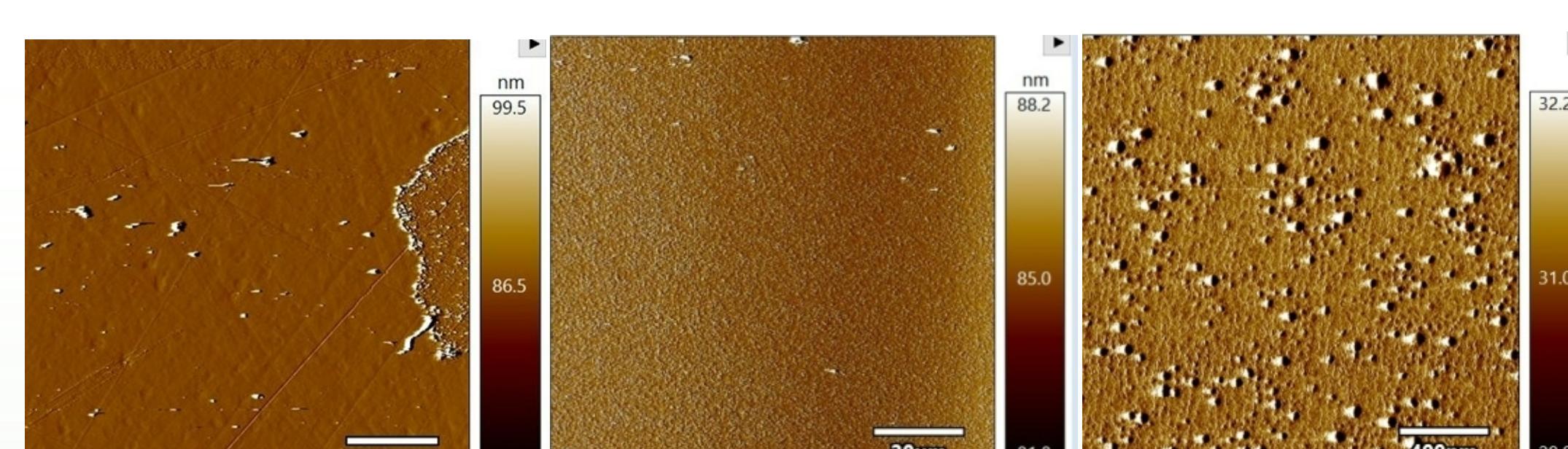
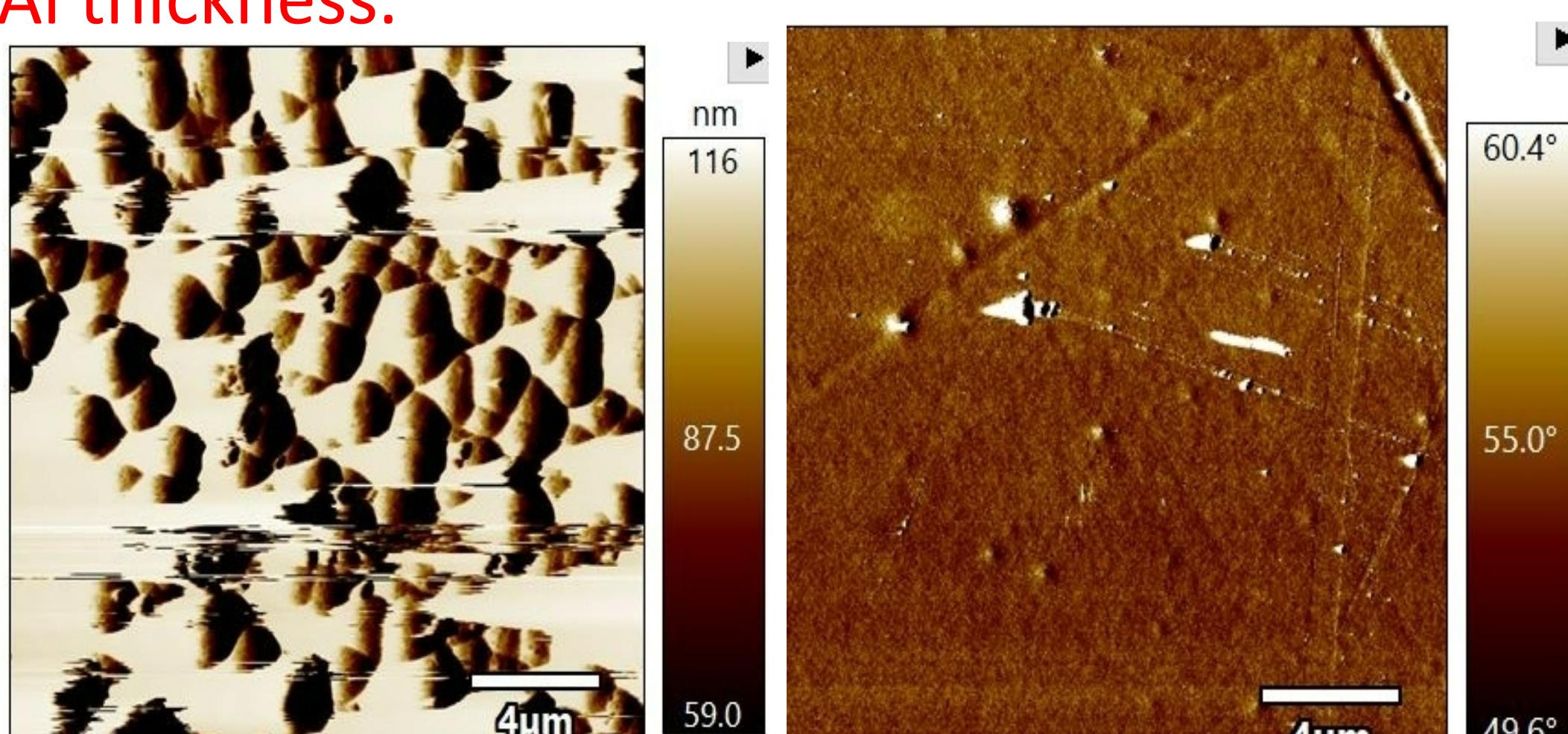
Standard CTLM devices are not expected to work for characterizing the contacts. The current is not confined to a single epi layer (a basic assumption of the theory), but rather is free to travel through the very thick substrate.

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.

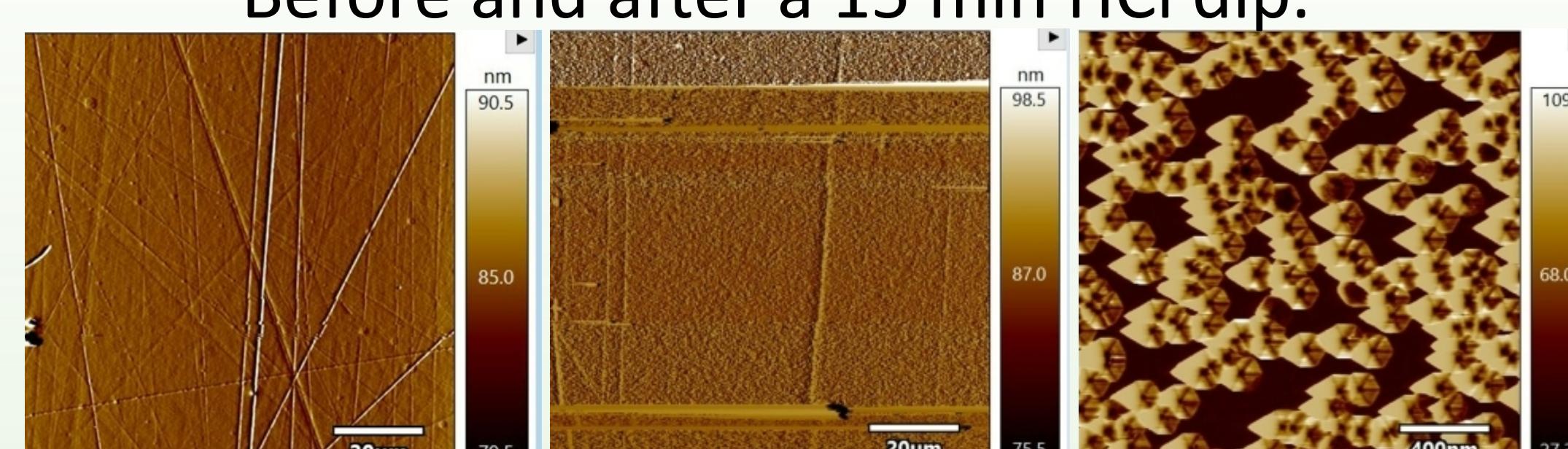


Results

- 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.