

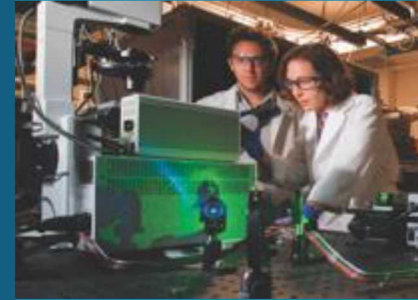


Sandia
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Determining Steel Corrosion Rates Under Waste Isolation Pilot Plant Conditions



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PRESENTED BY



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Personal Background



- Worked at Carlsbad office for 4 years
- B.S. in Chemical Engineering
- Pursuing M.S. in both Materials and Metallurgical Engineering and Engineering Management
- Will pursue engineering management job Summer 2020

Waste Isolation Pilot Plat (WIPP)



- Deep geologic repository for transuranic (TRU) waste
- TRU waste is stored 660m underground in the 380m thick Salado formation
- First barrel of waste was placed underground in 1999.



Remote-Handled
Waste

Contact-Handled
Waste

Figure 1. Waste emplaced in panels underground at the WIPP



- Steel corrosion could produce significant gas generation
- Corrosion rate and mechanisms must be determined
- Various rate determination methods
- Static, Flow-thru, and Electrochemical set-ups
- Experiments conducted at 90 C

Experimental Set-up



Figure 2. *Glovebox setup for anaerobic flow-through experiments at Sandia Carlsbad facilities.*

Flow-through Process



Figure 3. *Simplified schematic of flow-through setup process*

Sample Results

- Simplified Brine Solution (no sulfide)
- 3.5 M NaCl + 1.0 M MgCl₂

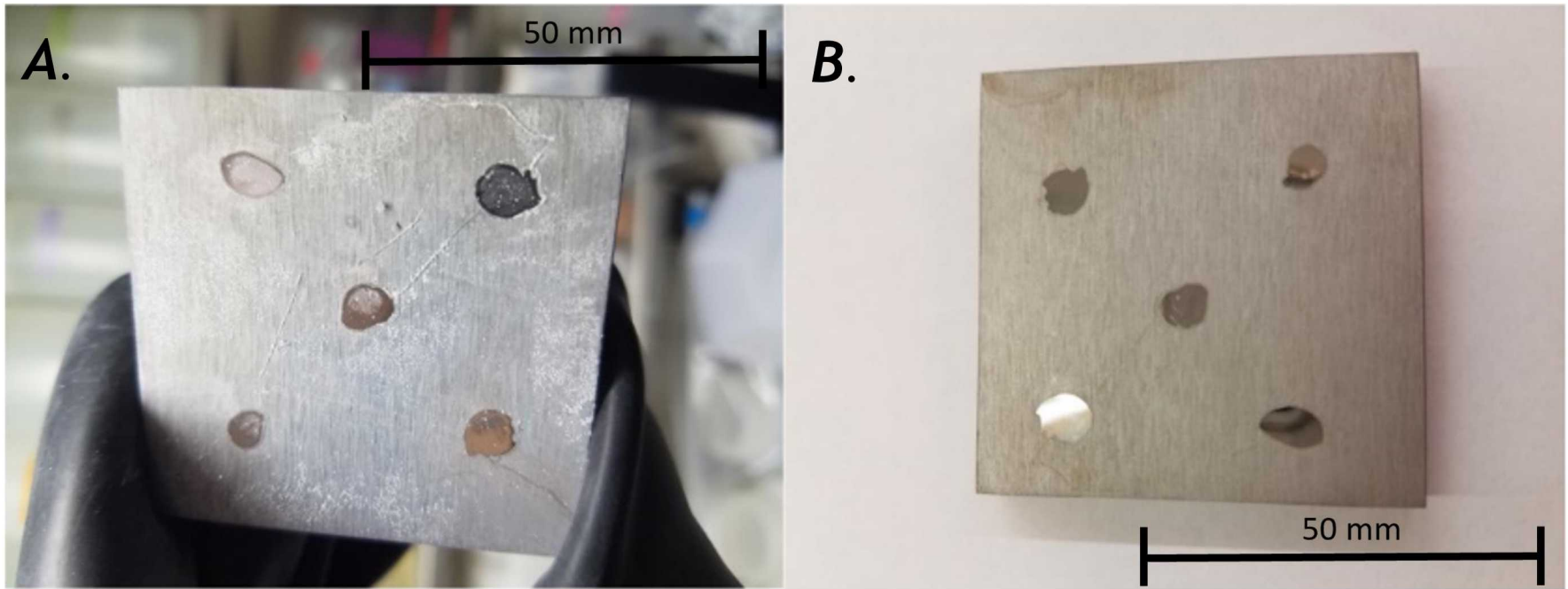


Figure 4a. C1018 steel coupon with masking removed after ~5 months in the flow-through setup (sulfide free simplified brine). **Figure 4b.** C1018 steel coupon after cleaning procedure (ASTM G 1 - 03)

Sample Results



- Simplified Brine Solution (with sulfide)
- 3.5 M NaCl + 1.0 M MgCl₂ + 10mM NaHS

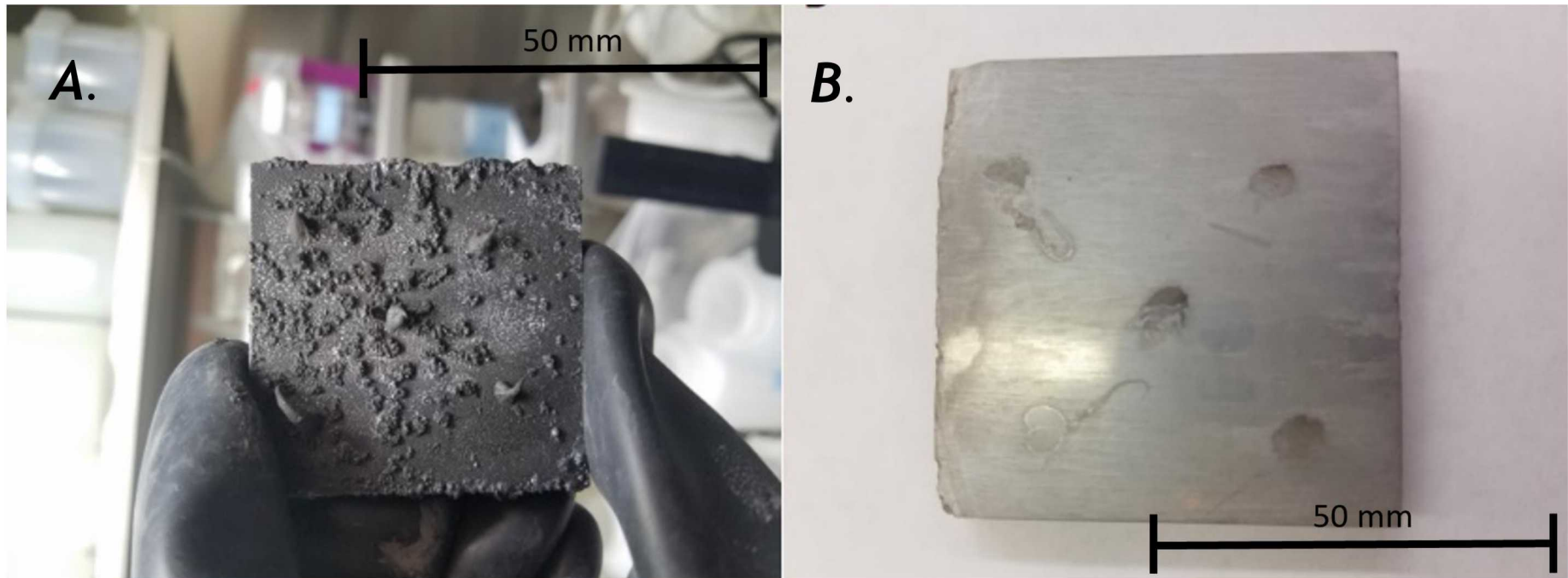
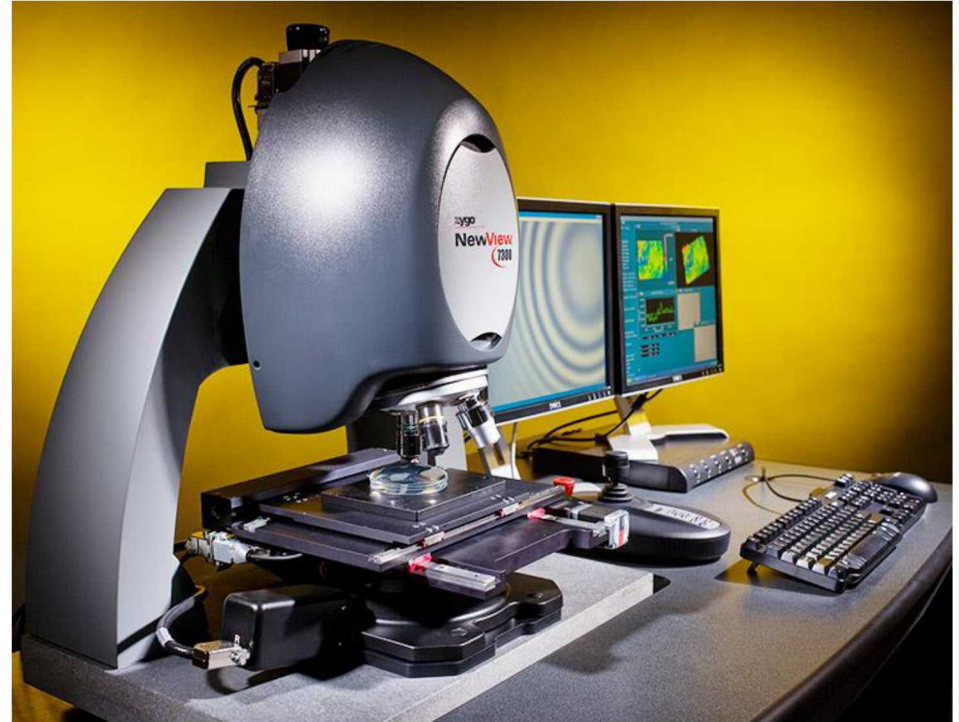


Figure 5a. C1018 steel coupon with masking and corrosion products after ~5 months in the flow-through setup (sulfide bearing simplified brine). **Figure 5b.** C1018 steel coupon after cleaning procedure (ASTM G 1 - 03)

Interferometry



- Used to measure small displacements, typically in astronomy, seismology, etc.
- Novel idea for measuring corrosion rates



Interferometry

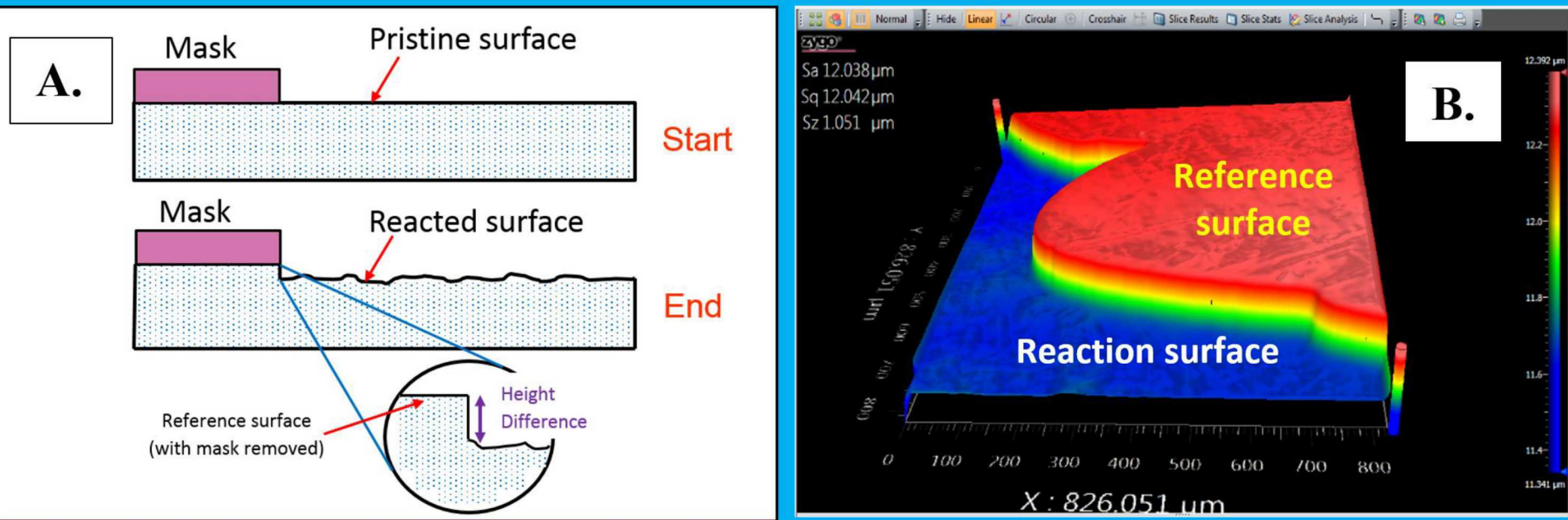


Figure 6a. Visualization of method for measuring surface retreat on steel coupons. **Figure 6b.** Interferometry image showing masked vs. unmasked surface after reaction.

Interferometry Results

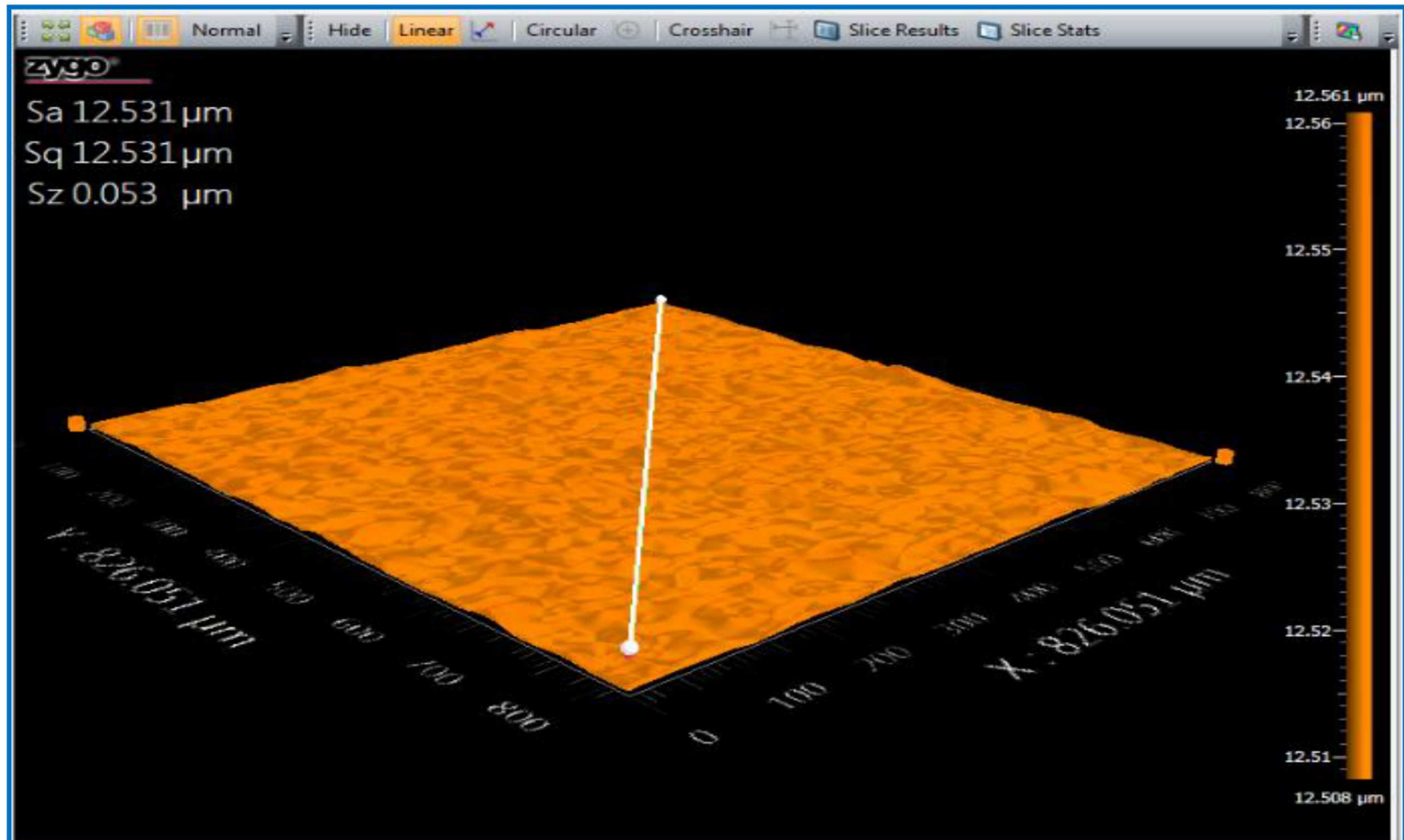


Figure 7. *Interferometry image of unreacted pristine surface*

Interferometry Results

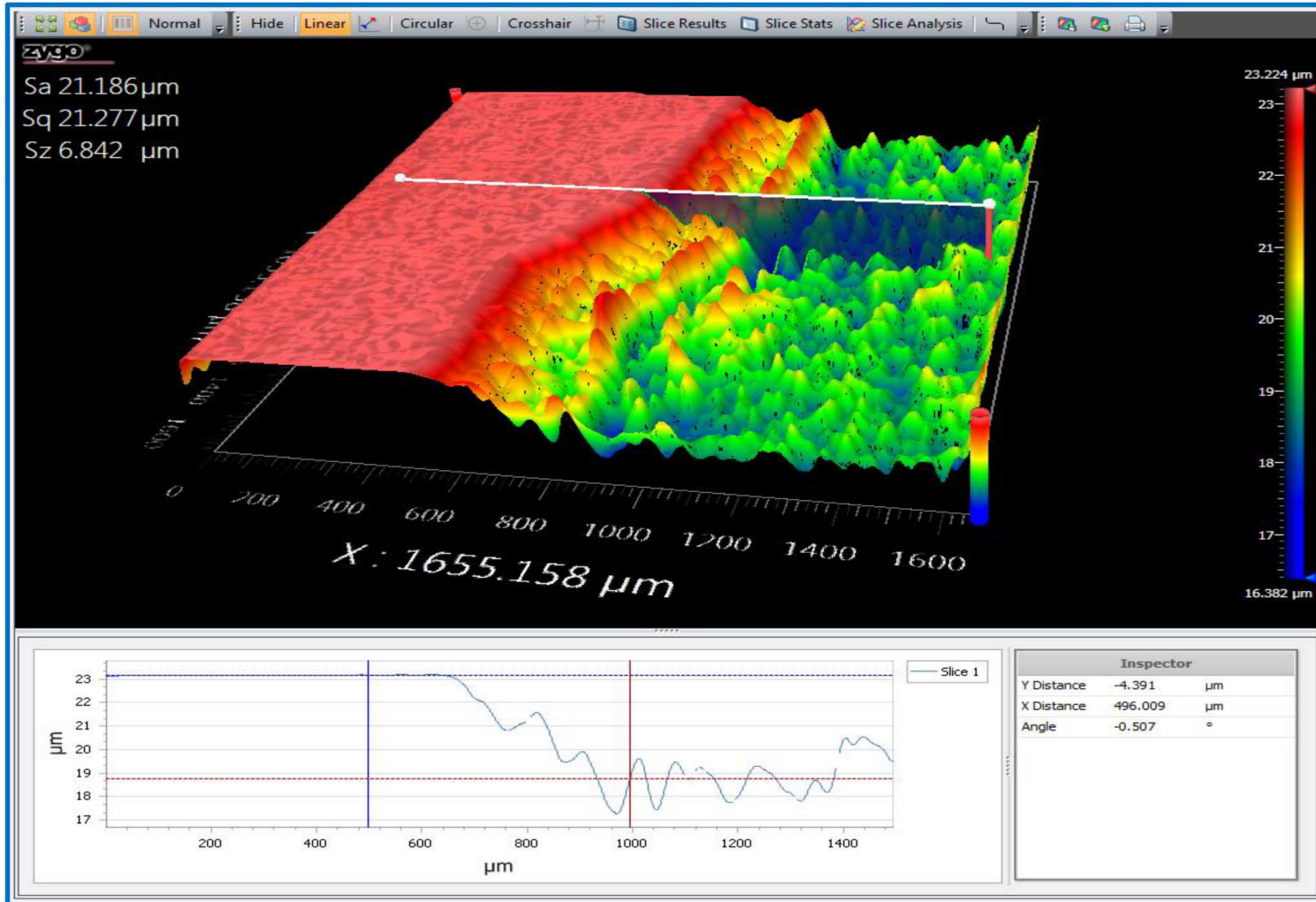


Figure 8. Interferometry results of coupon reacted in sulfide bearing simplified brine. Step change ~ 5 micrometers

Conclusion



- Interferometry seems to be a promising method for determining corrosion rates
- Corrects for inaccuracies in other methods like weight loss
- Interferometry measurements will be confirmed with electrochemical tests