

Performance of Alumina-Forming Alloys in Decoking Atmospheres

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Introduction



Figure 1: Everyday plastics made of polyethylene (PE).



Figure 2: Large factory where PE is made.

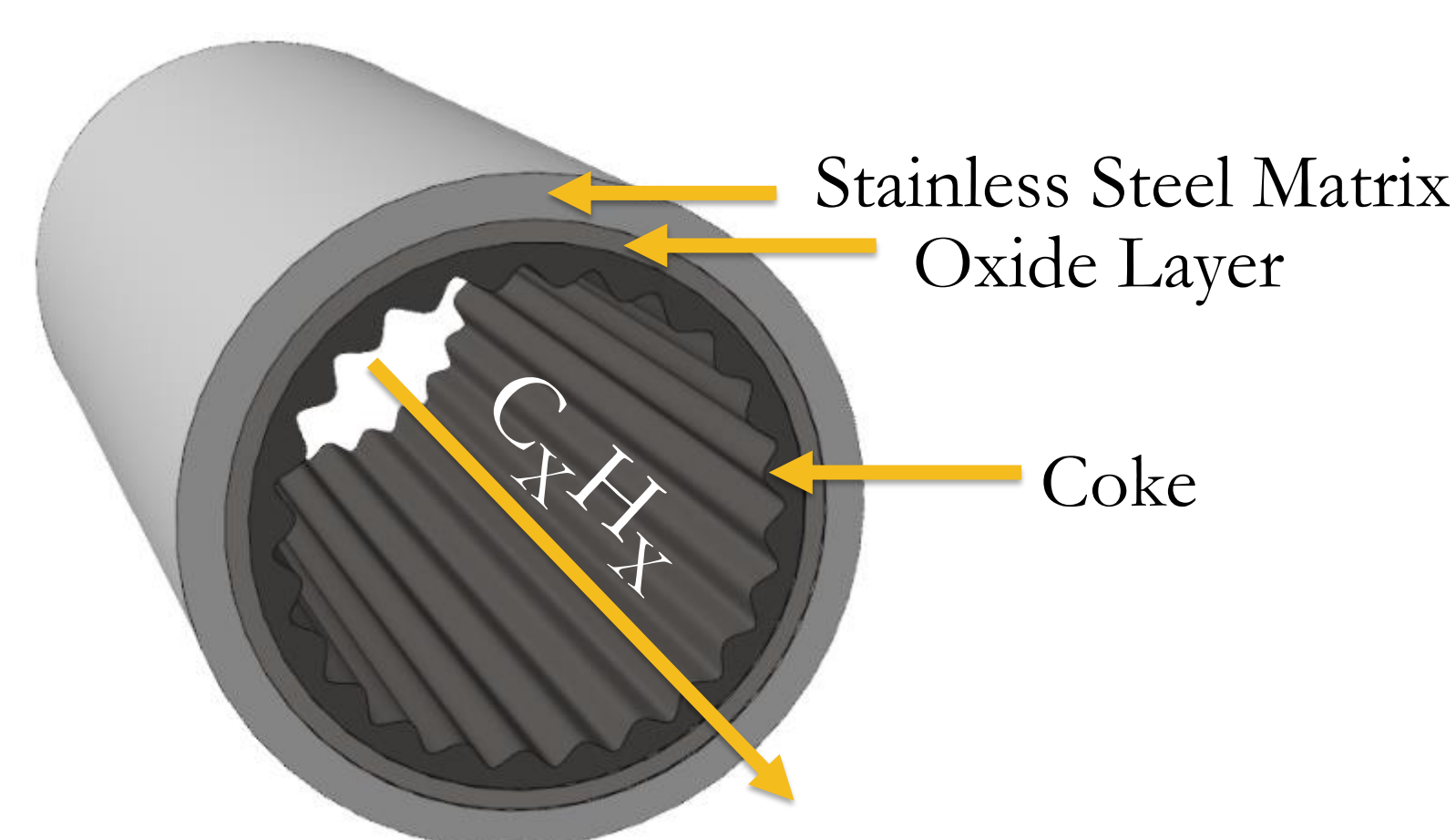
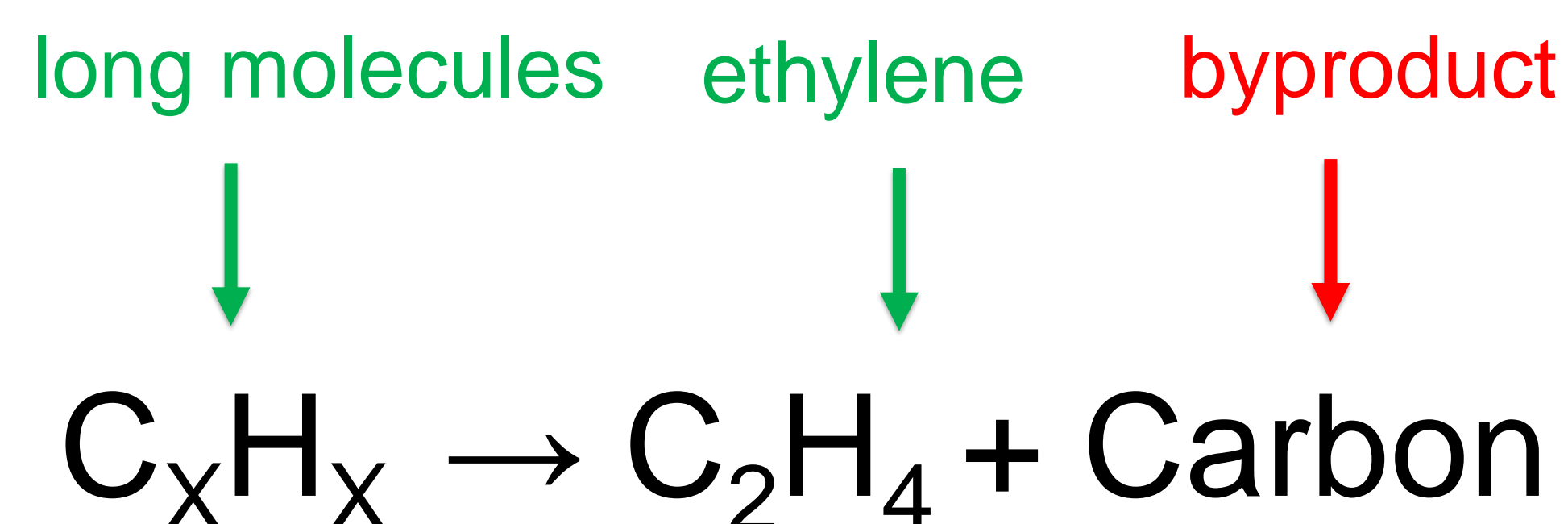


Figure 3: Representation of carbon buildup.

- Carbon buildup (or coke) = high operational costs = bad for environment
- New Alumina-forming alloy (AFA) vs traditional Chromia-forming alloy (CFA)

Experimental Procedure

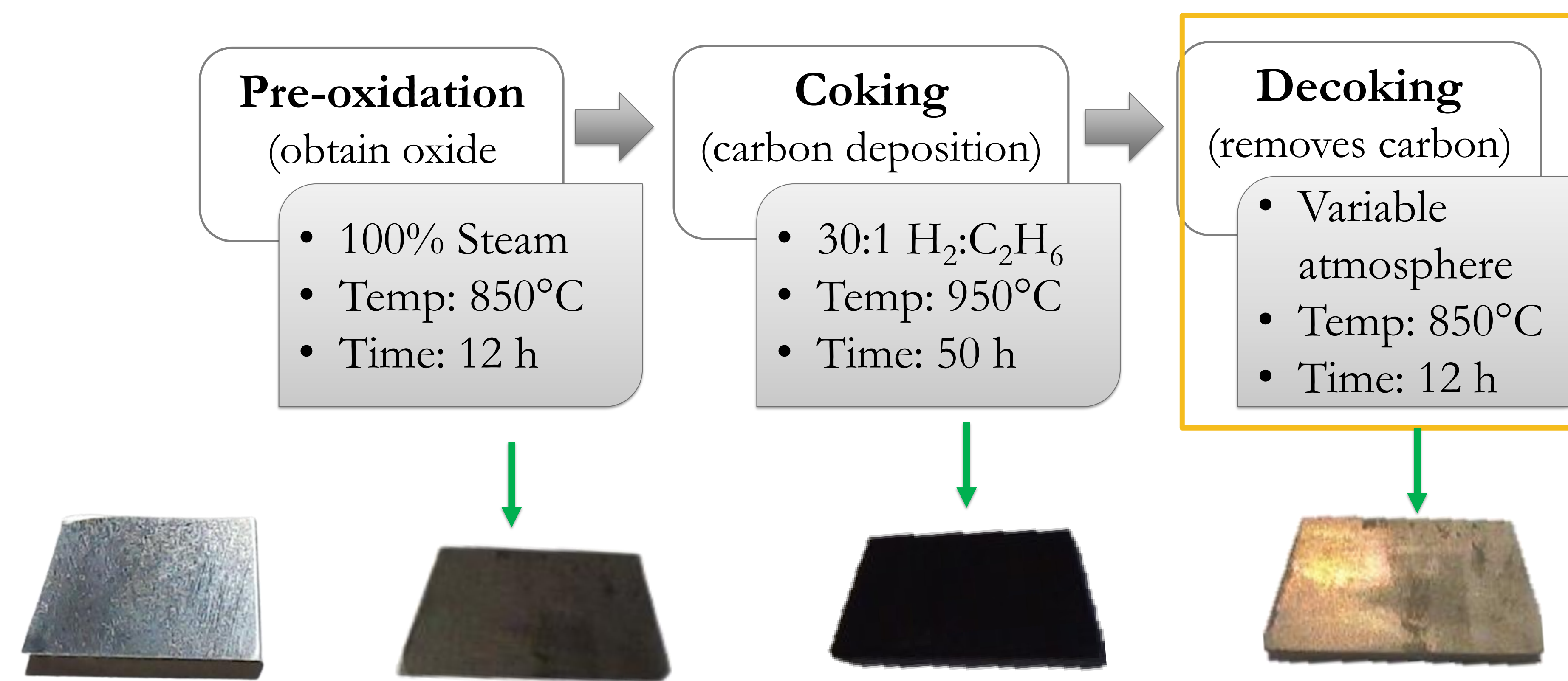


Figure 4: Images of as-received, pre-oxidized, coked and decoked procedure for AFA alloys.. Scale bar at ~2 cm.

Decoking reaction: $O_2 + C = CO_2$

- ↑ Oxygen = ↑ Decoking

Three atmospheres were tested:

- 100% Steam $P_{O_2} = 10^{-6} atm$
- Steam – Air $P_{O_2} = 10^{-3} atm$
- 100% Air $P_{O_2} = 10^{-0.6} atm$

Results

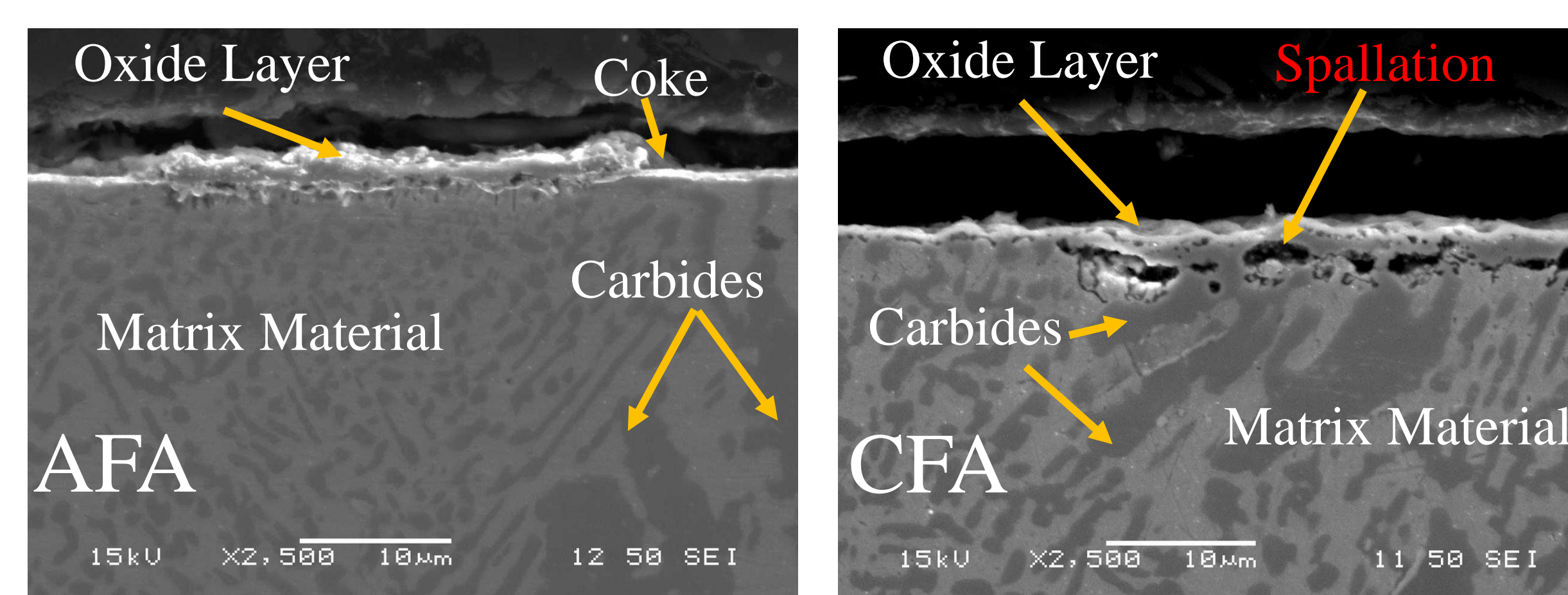


Figure 5: SEM microstructure after moderate decoking procedure for AFA and CFA alloys.

Takeaways:

- ↑ Oxygen = ↑ Aggressive
- AFA better than CFA
- CFA gained mass- why?

Takeaways:

- CFA spalled, non-uniform
- Similar structures

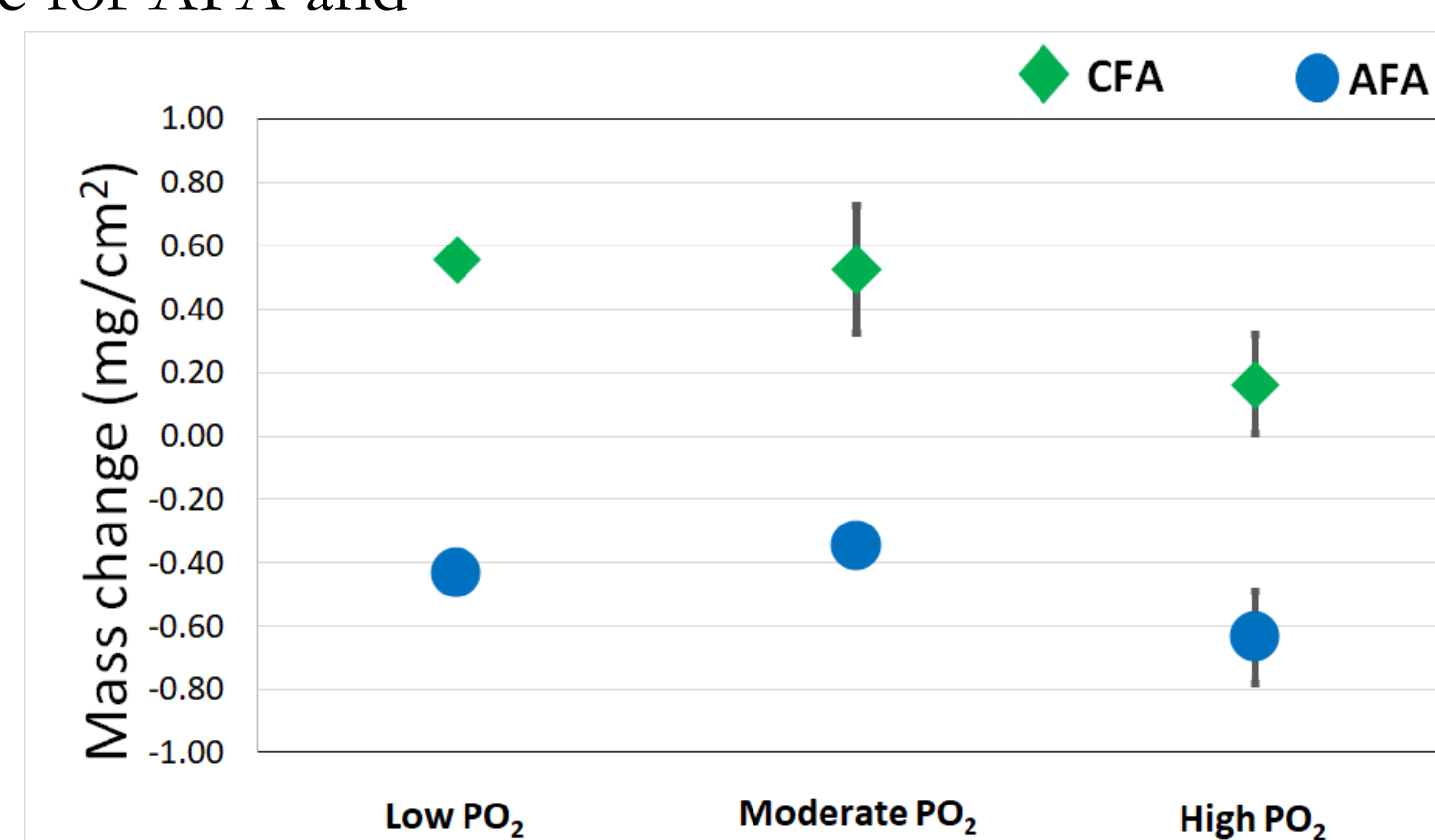


Figure 6: Mass changes in all decoking atmospheres for both alloys. 2 samples per data point.

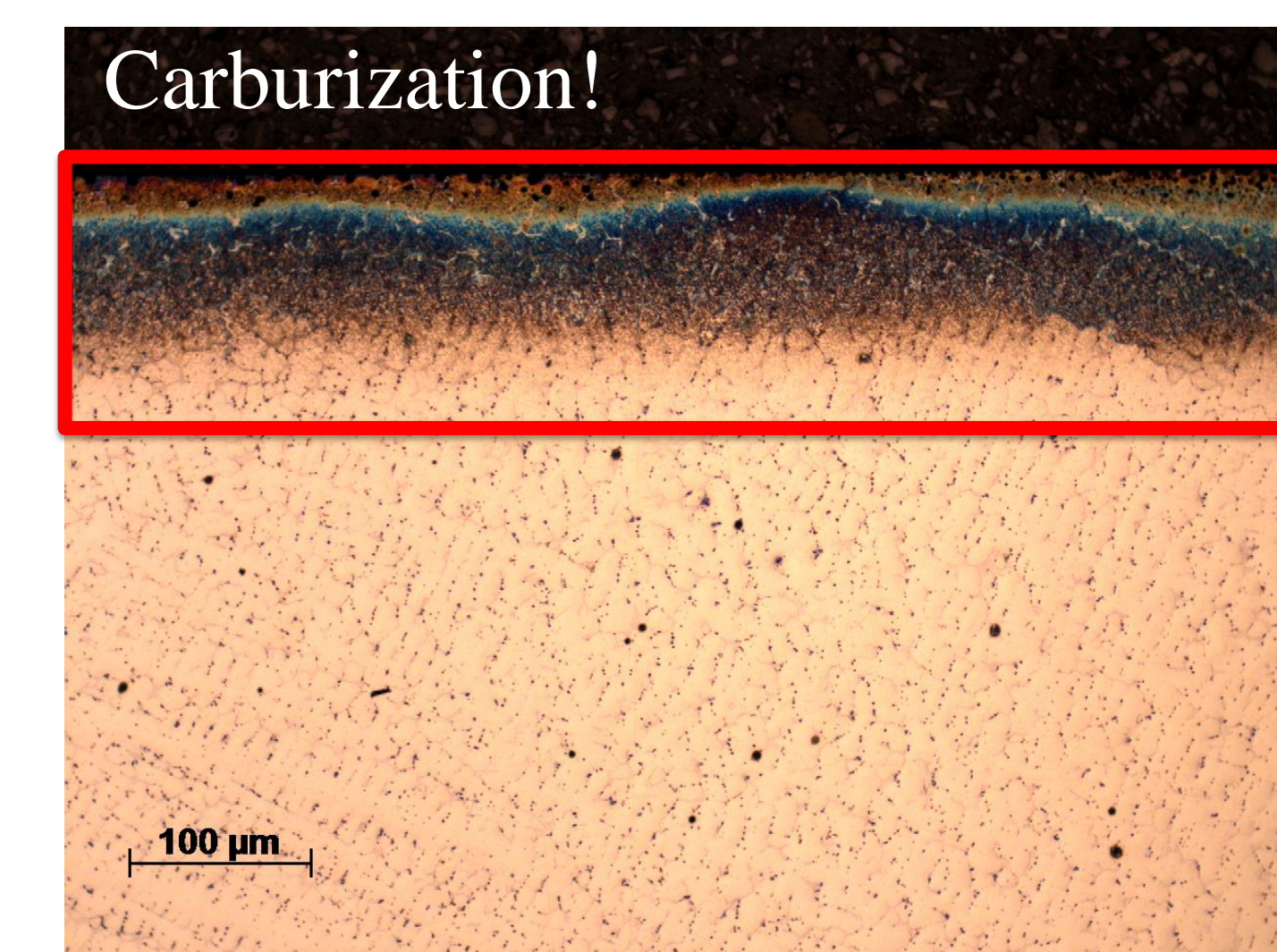


Figure 7: Optical micrograph at 500x, etched with diluted HF etchant, CFA, and at high PO₂ decoking.

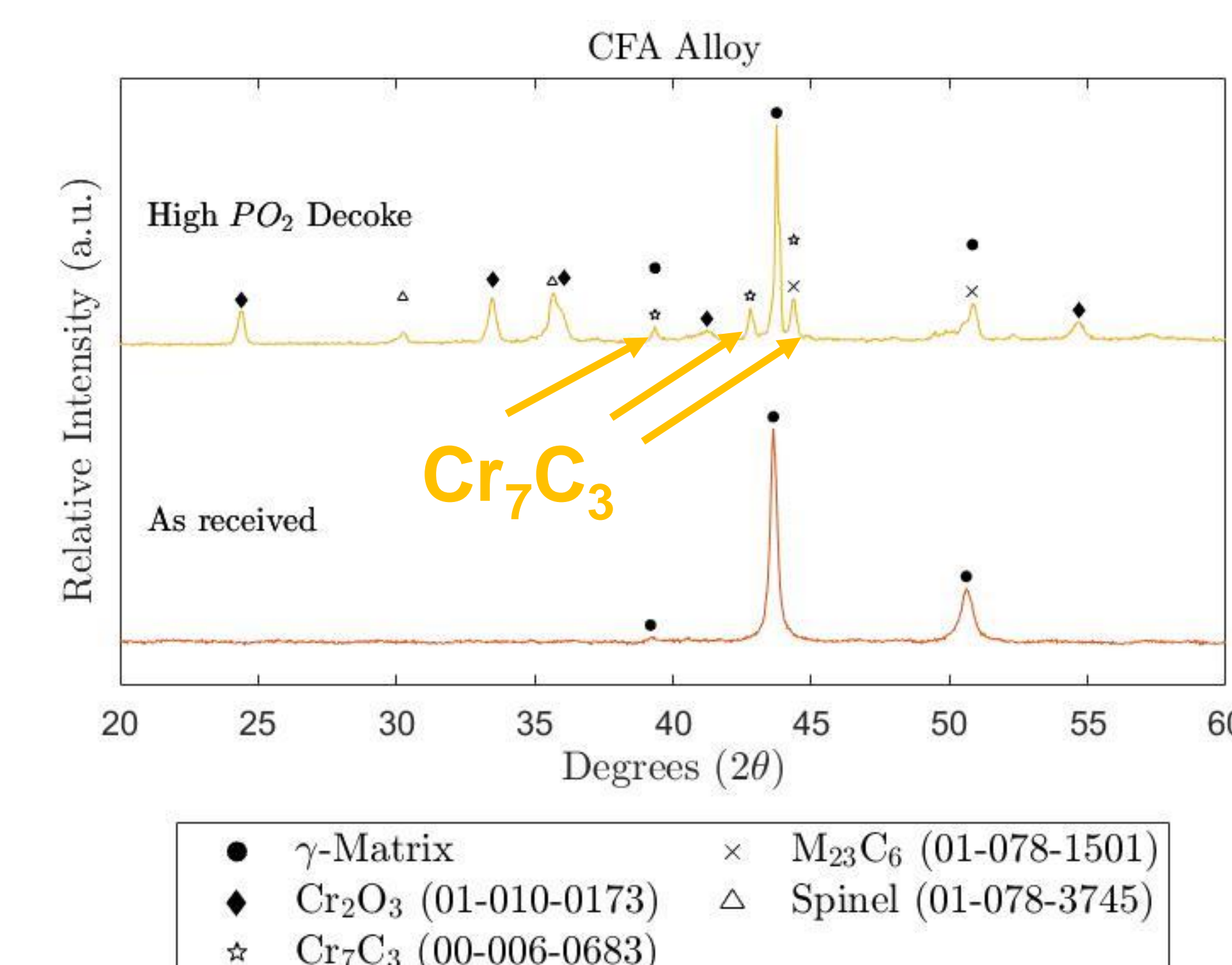


Figure 8: XRD showing as-received and decoked condition.

Takeaways:

- In testing, both alloys develop carbides
- Both have protective oxide layers & spinels

Conclusions

- AFA decoked better
- High PO₂ is more aggressive
- CFA carburated more
- CFA – non-uniform oxide layer

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For further information

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