

Influence of Surface Treatment on Hydrogen Embrittlement of Commercial Vehicle Seat Slider Bracket

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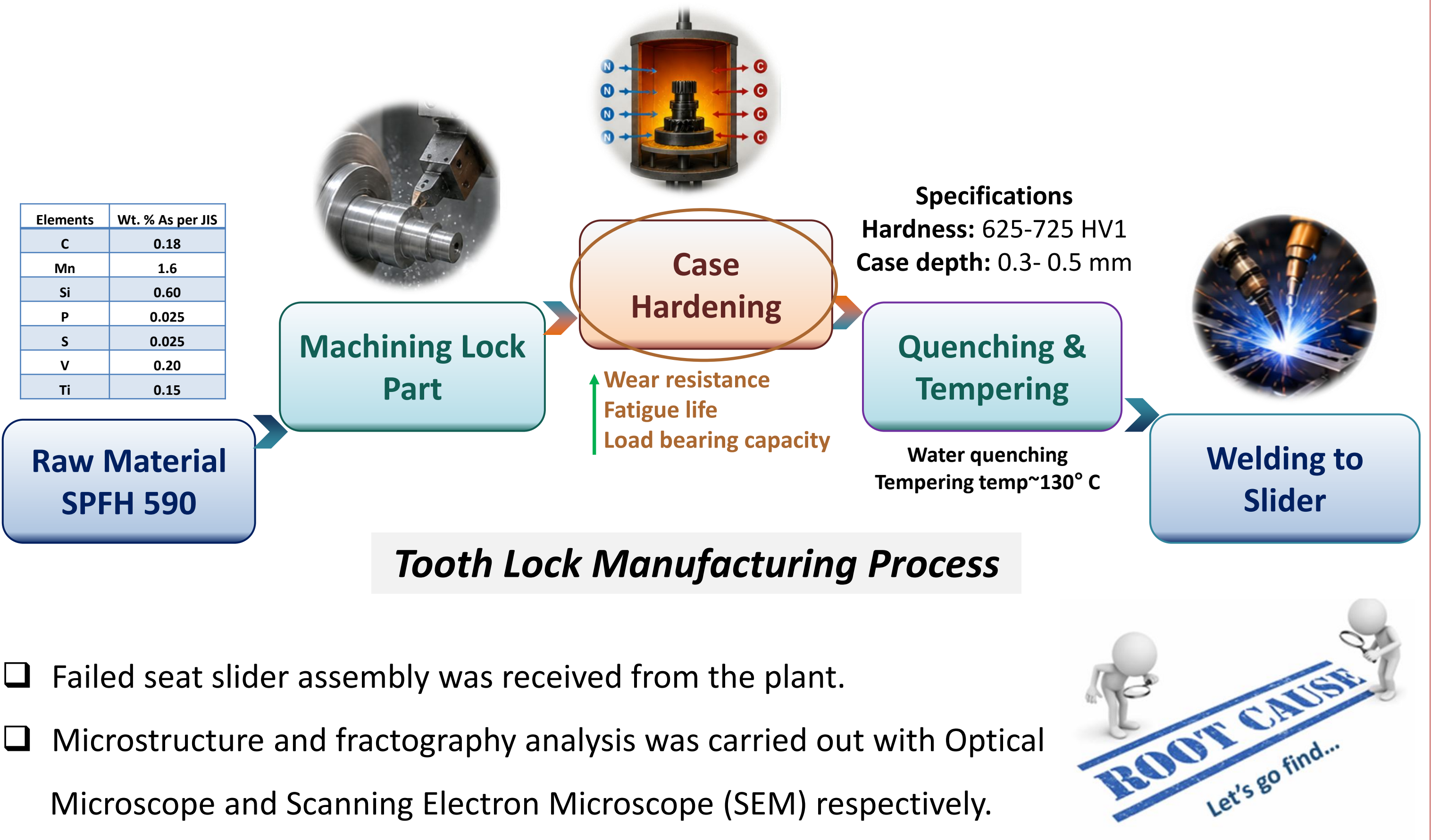
PRODUCT INTRODUCTION

- ❑ Pneumatic seats are designed for multidirectional movements and are equipped with seat slider assembly with locking bracket.
- ❑ The toothed design of bracket engages with seat slider for linear back-forth movement of the seat.

Problem statement: Tooth lock was found broken in the failed seat slider assembly.

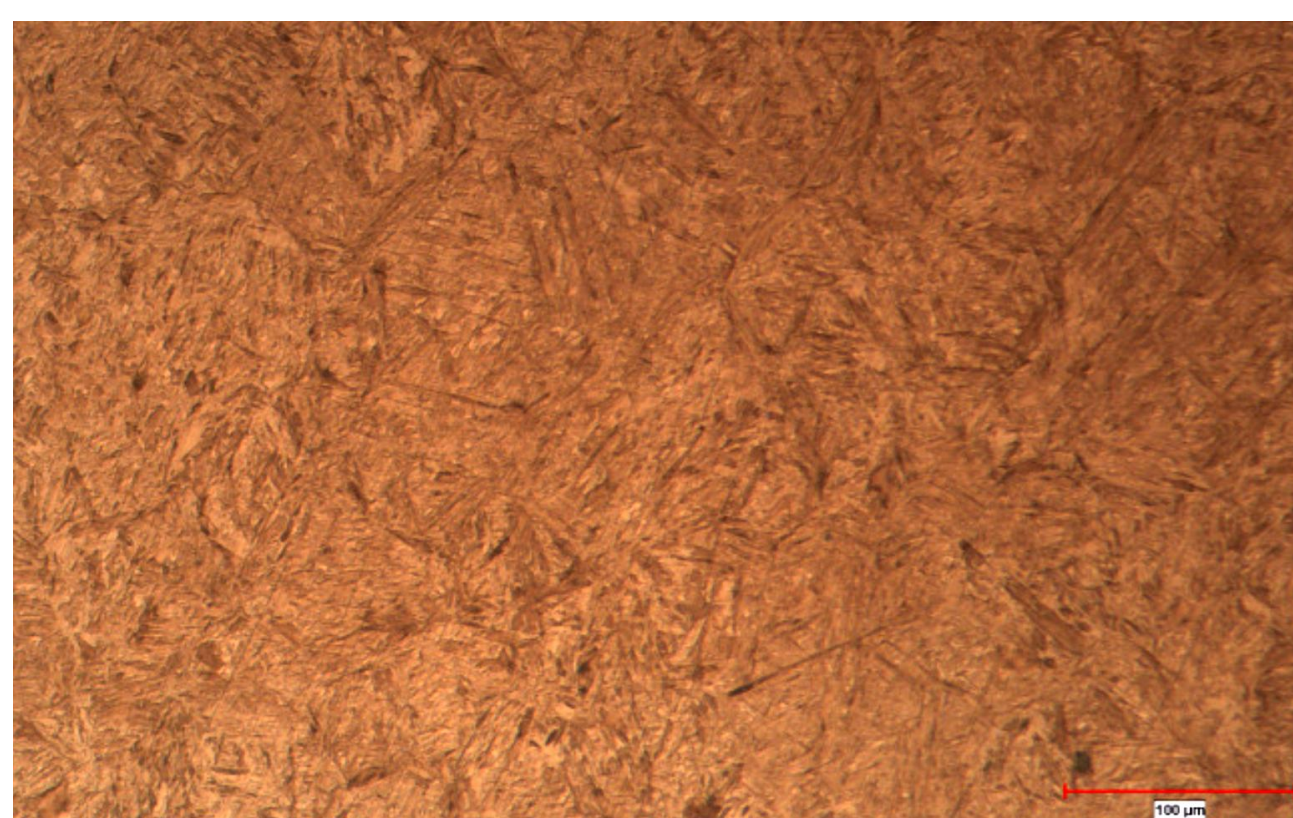


MATERIAL & METHOD



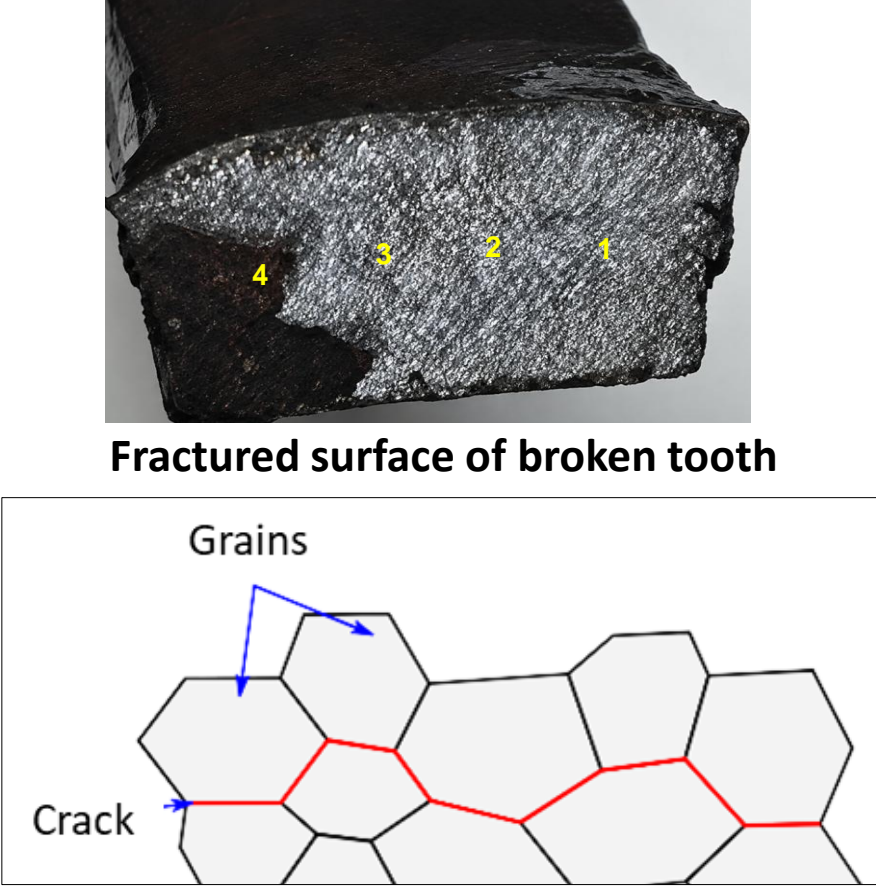
RESULTS & DISCUSSION

Optical Microstructure



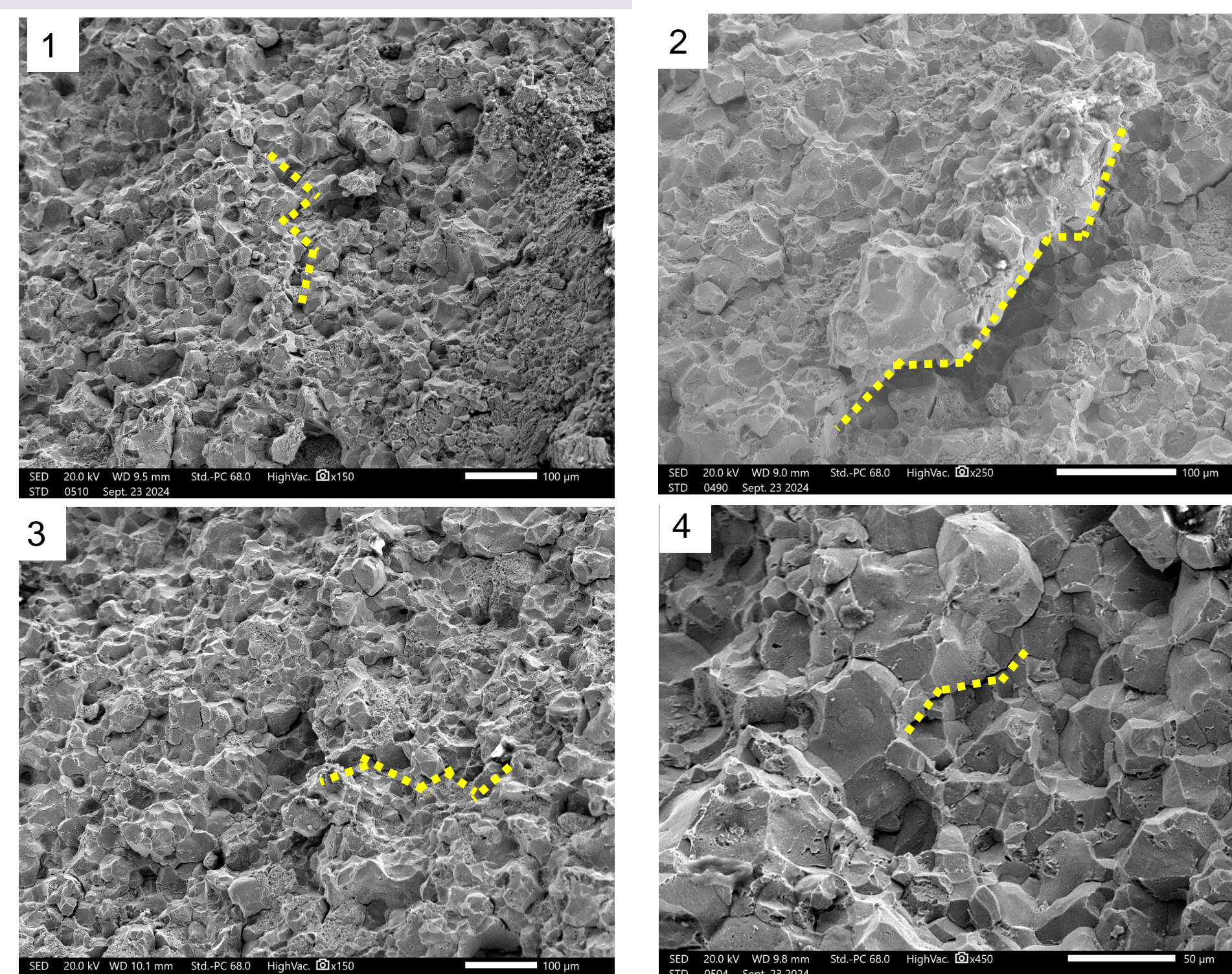
- ❑ The observed microstructure predominantly consists of tempered martensite, characterized by a fine acicular (needle-like) or lath morphology arranged in small packet.
- ❑ The tempered martensite microstructure was observed in both case and core of the failed part.

Scanning Electron Microscopy

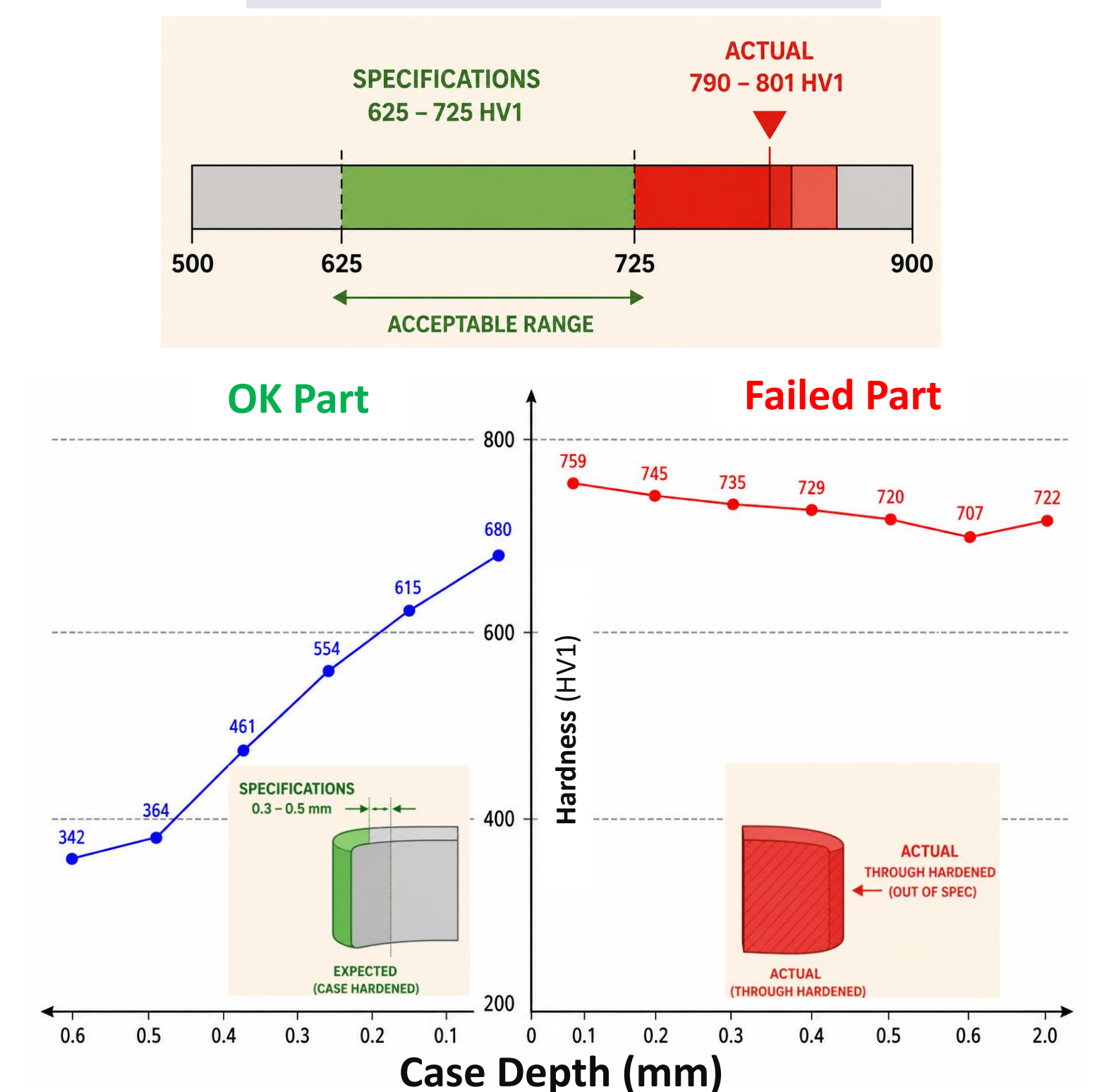


- ❑ Well defined grain boundary regions, cleavage fracture indicates brittle failure.
- ❑ No crack branching was observed.
- ❑ Intergranular fracture was observed as crack propagated along the grain boundaries.

Fractography Analysis

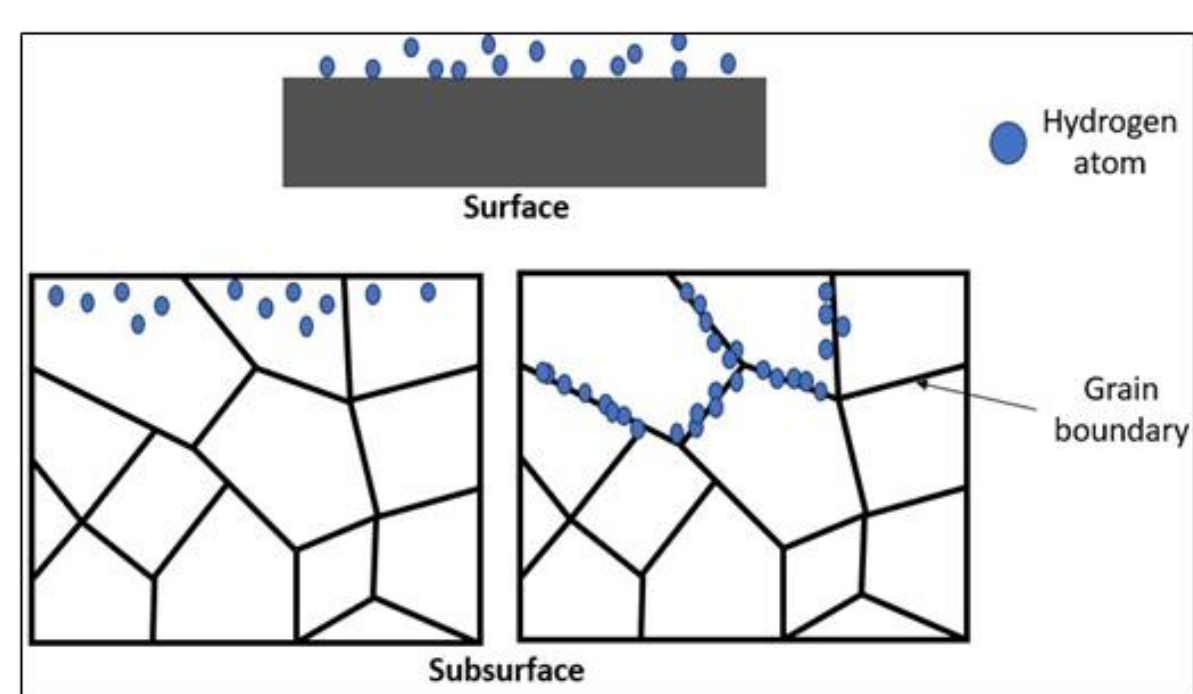


Hardness Analysis

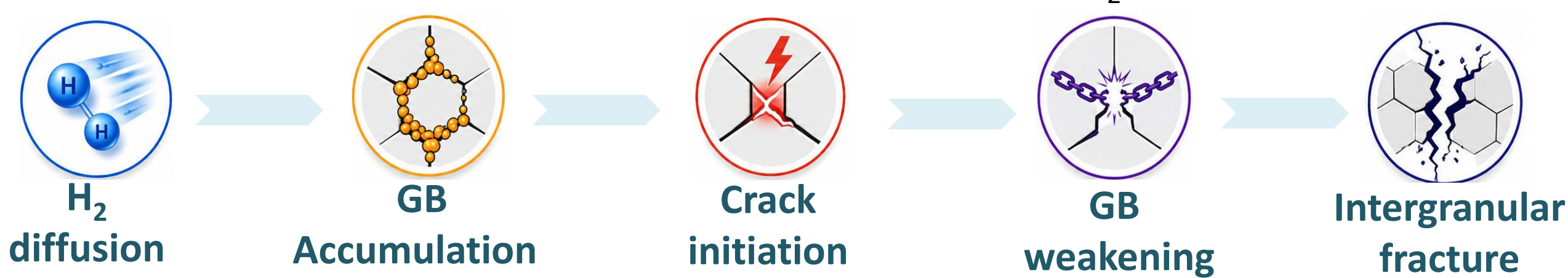


Root Cause: The intergranular fracture tend towards the hydrogen embrittlement susceptibility of tooth lock part of seat slider. This hydrogen embrittlement could be due to hydrogen pickup during heat treatment like carbonitriding or even tempering.

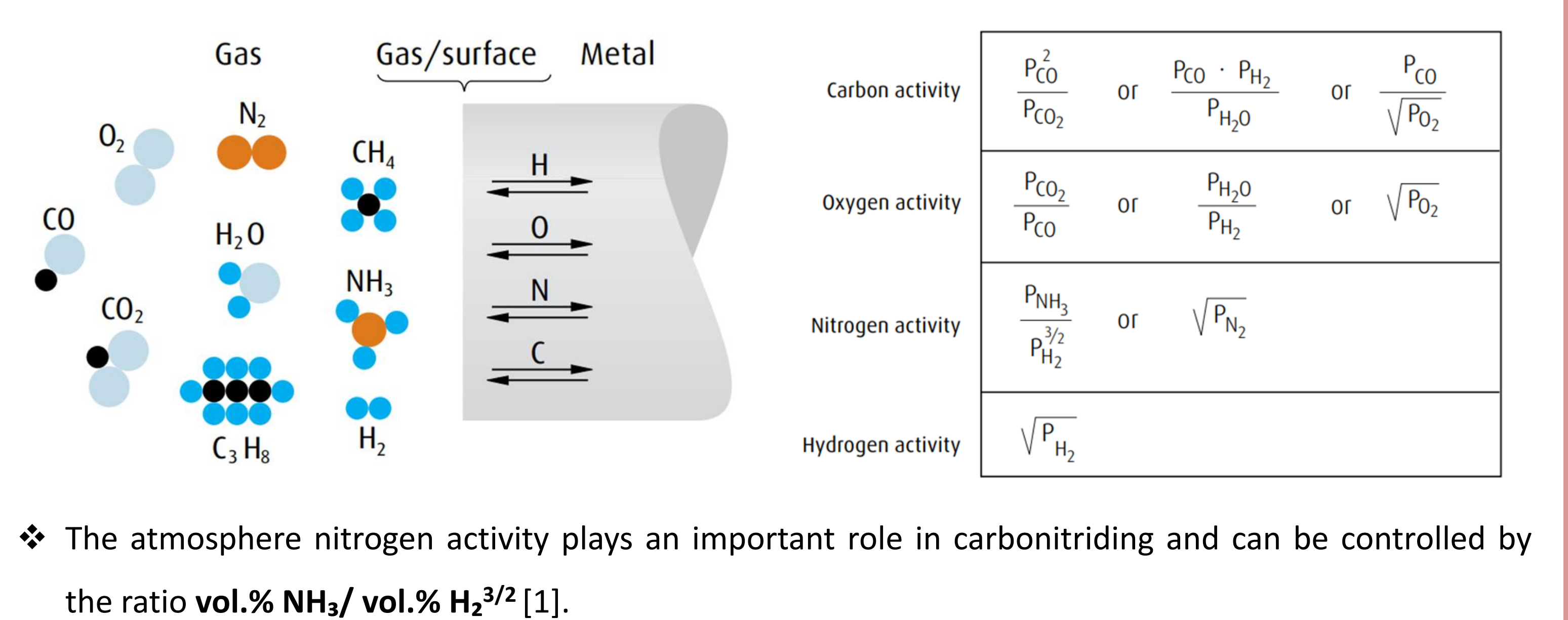
H₂ Embrittlement Mechanism



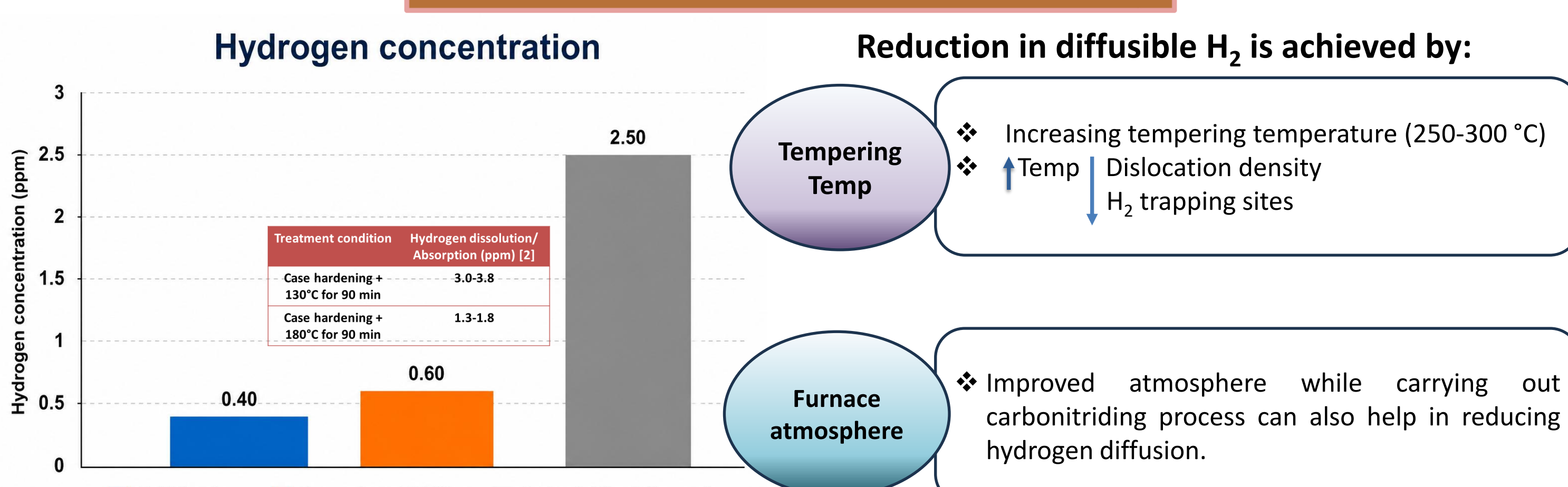
- ❖ H₂ can be diffused as H⁺ ions during processes like electroplating, carburizing, and welding.
- ❖ Leads to reduced ductility and lower load bearing capacity resulting brittle fracture.
- ❖ **High hardness and dislocation density** create trapping sites for H₂.



Possible H₂ pick up during Carbonitriding



PREVENTION



Implementation of these changes resulted in **no failure in seat assembly tooth lock.**

CONCLUSIONS

- ✅ Identified root cause: H₂ pick up on the tip of the tooth during hardening treatment
- ✅ Increase in hardness induced during heat treatment, amplified the materials susceptibility to H₂ penetration and subsequent cracking.
- ✅ Corrective actions on heat treatment process, and furnace environment are necessary.

REFERENCES

- [1] Grabke, H.J., 1990. Härterei-Technische Mitteilungen, Vol. 45.
- [2] P. Sommer, "Failures Caused by Hydrogen Absorption during Heat Treatment Processes," *Materials Testing*, vol. 56, no. 6, pp. 450-457, 2014