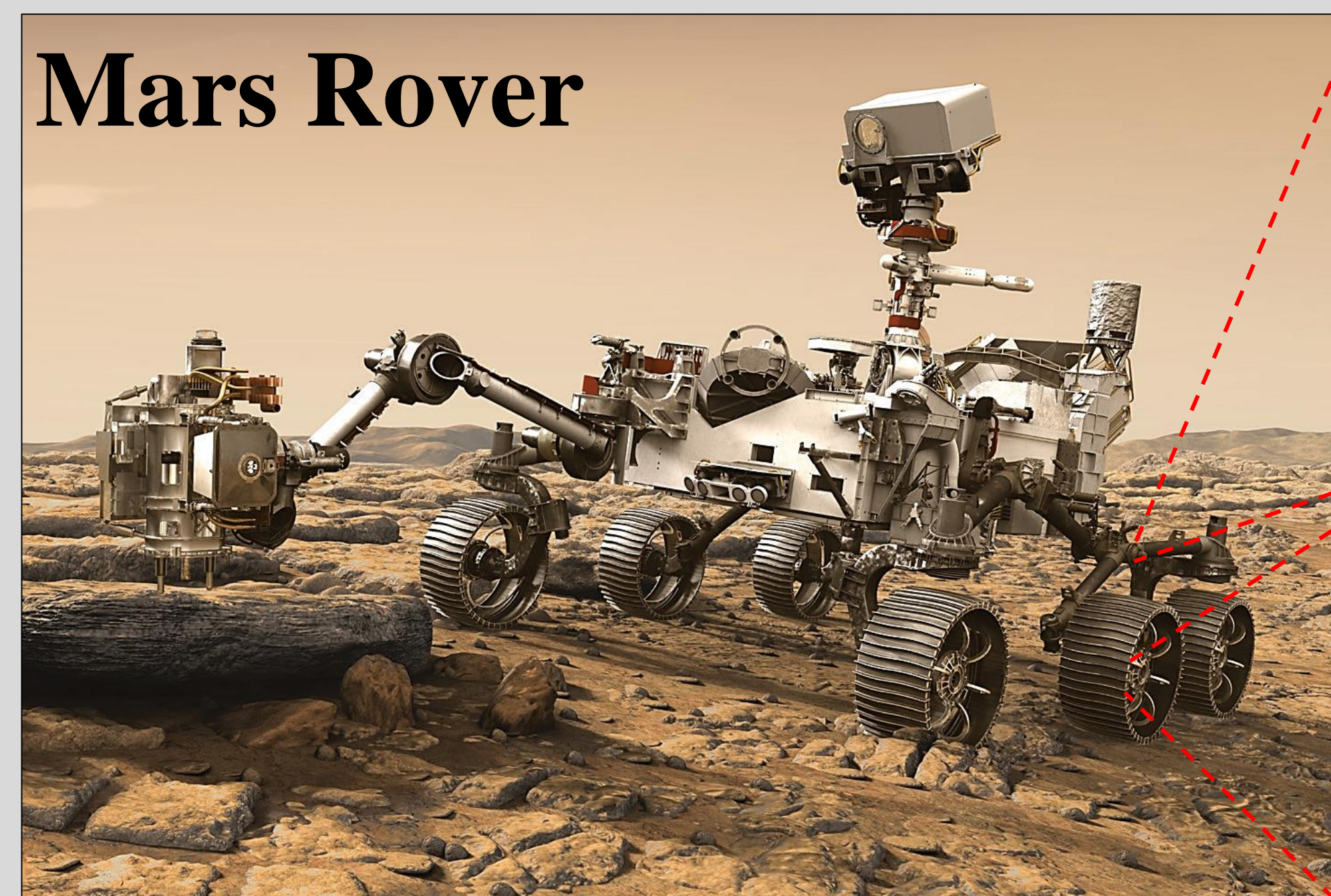


Introduction

- Mars has been a target for human colonization due to the possibility of human extinction on earth
- Various spacecrafts and structures must be sustainably utilized for successful exploration
- However, their mechanical parts can fail, thus presenting immense roadblocks
- There is a critical need to sustainably fix/manufacture these new components anywhere, anytime

Mars Rover



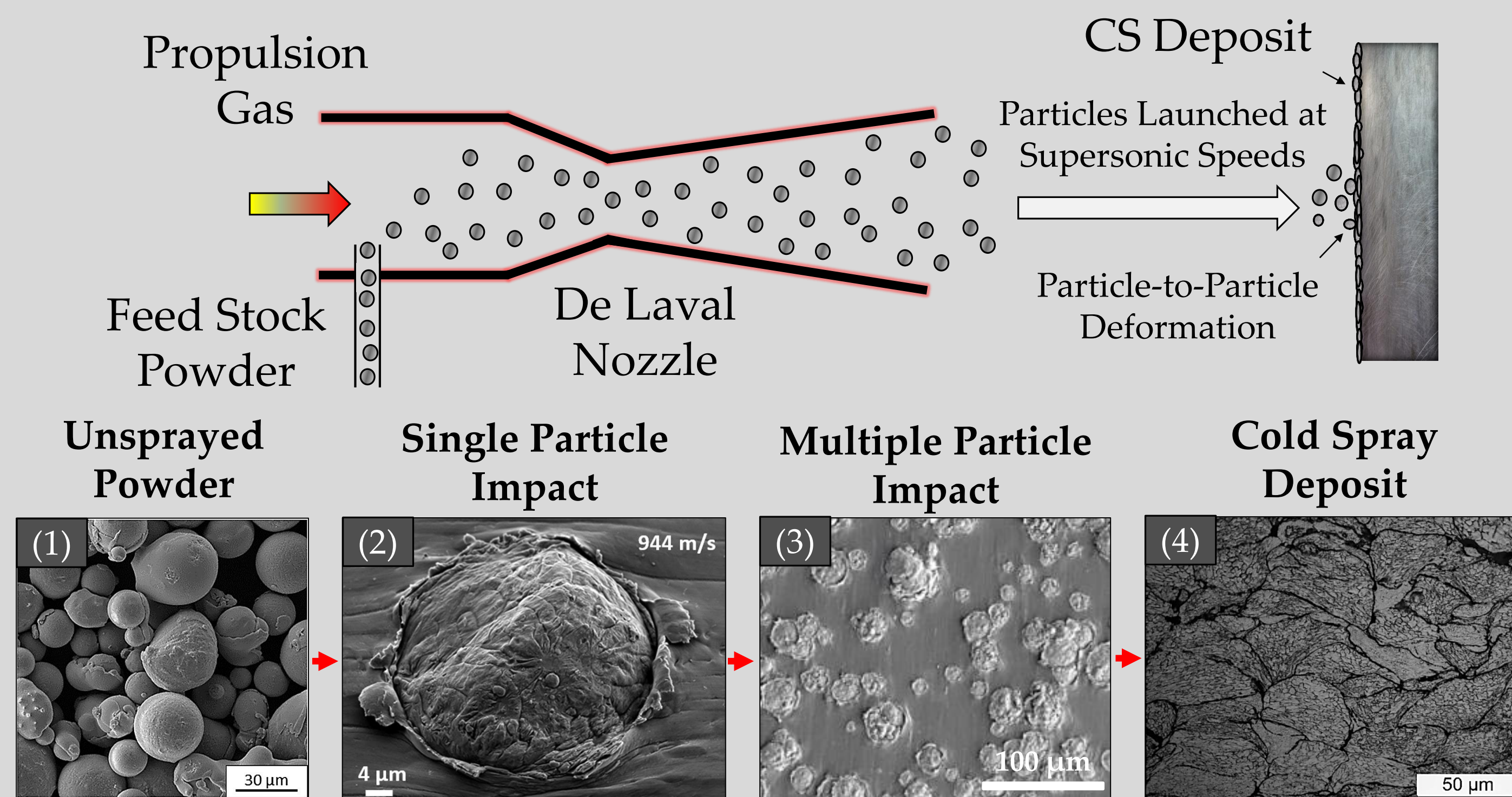
Gears



Bearings



Novel Solid-State Deposition Technique Known as **Cold Spray (CS)** Can Effectively **Fabricate/Repair Components**



However, defects such as pores, voids, and embrittlement hamper the full usability of CS deposits



We propose the **novel application** of post-laser processing to understand and improve the tribo-corrosion mechanisms of CS deposits for Mars exploration

Materials and Methodology

- CS deposit was fabricated by using a state-of-the-art high-pressure cold spray system

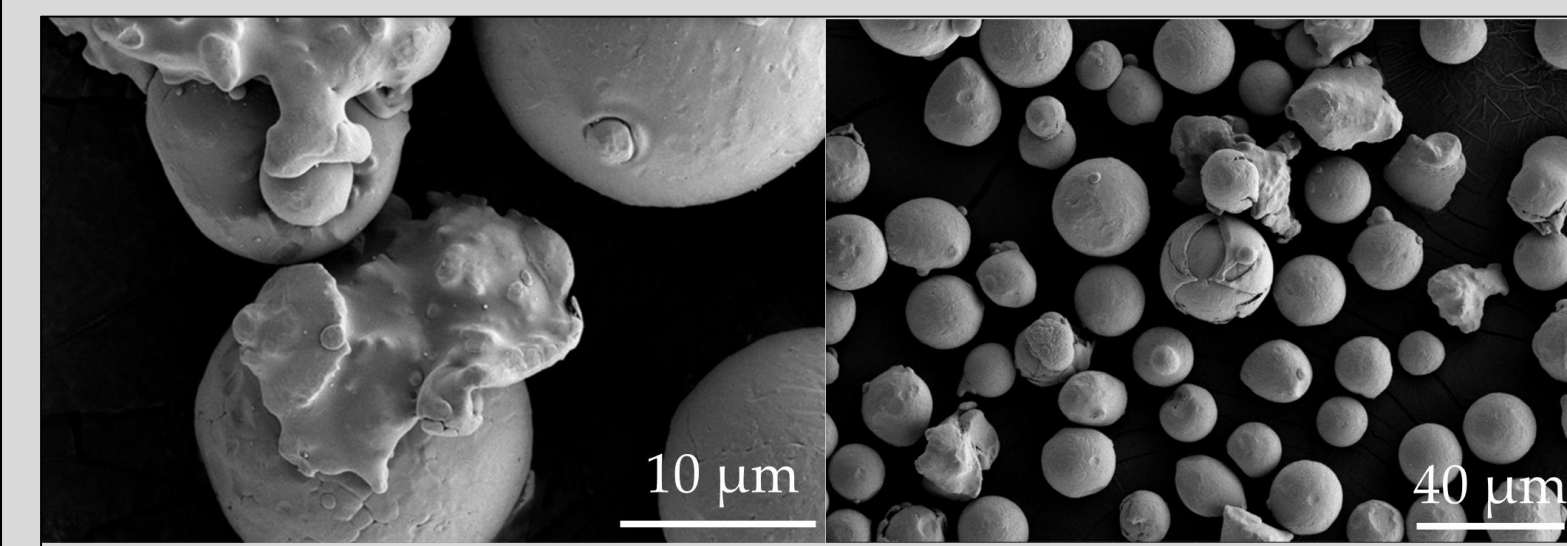


Fig. 1: Morphology of steel feedstock used for CS by BSE SEM.

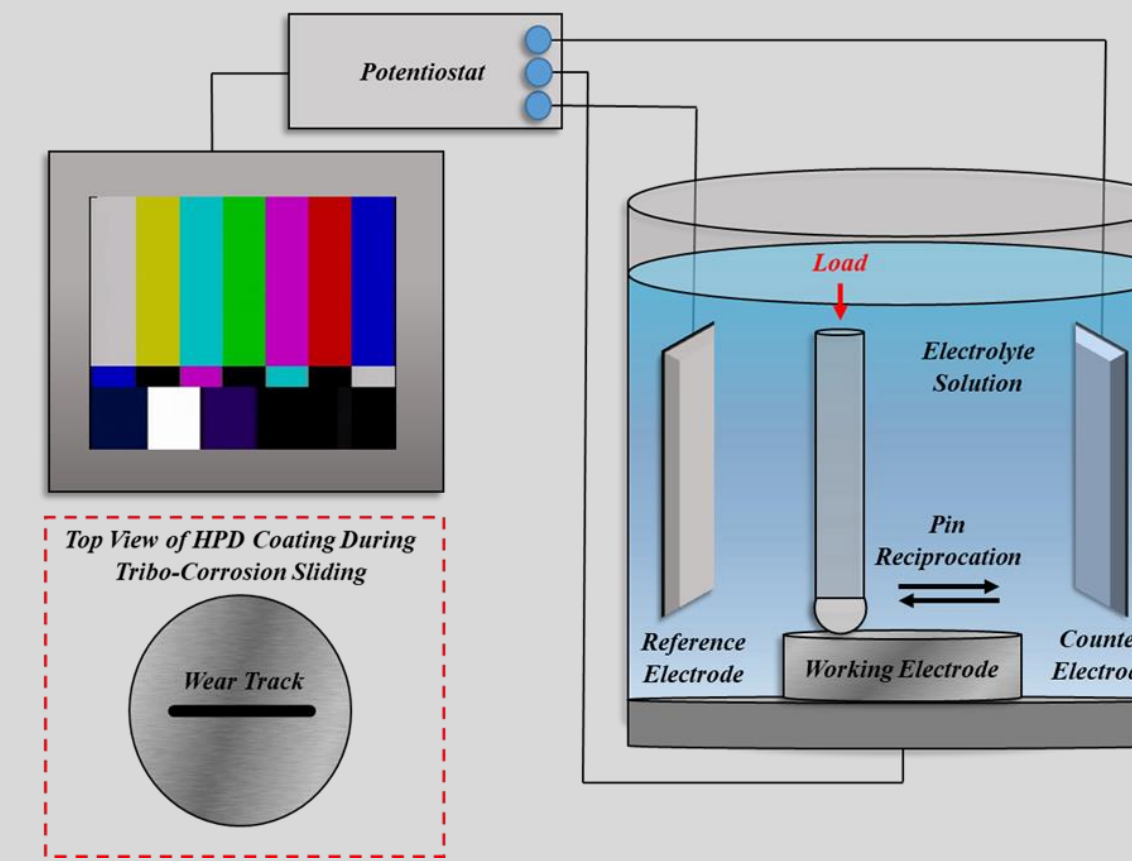
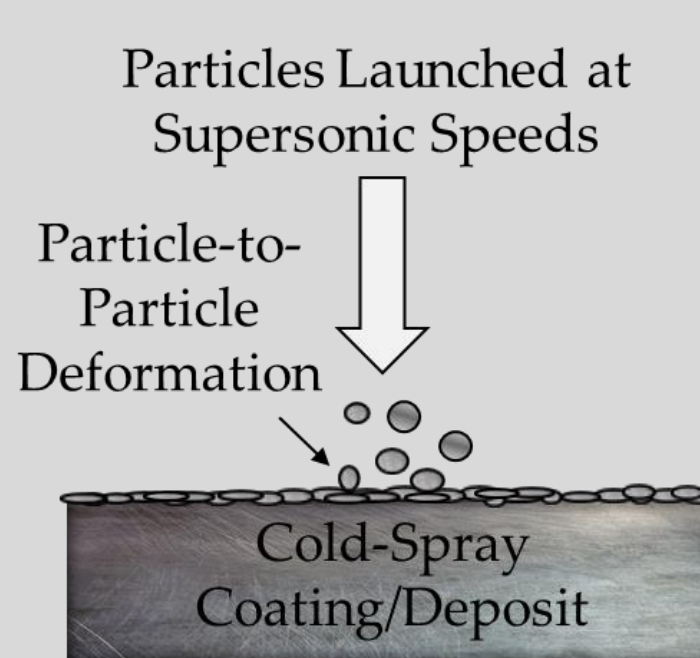
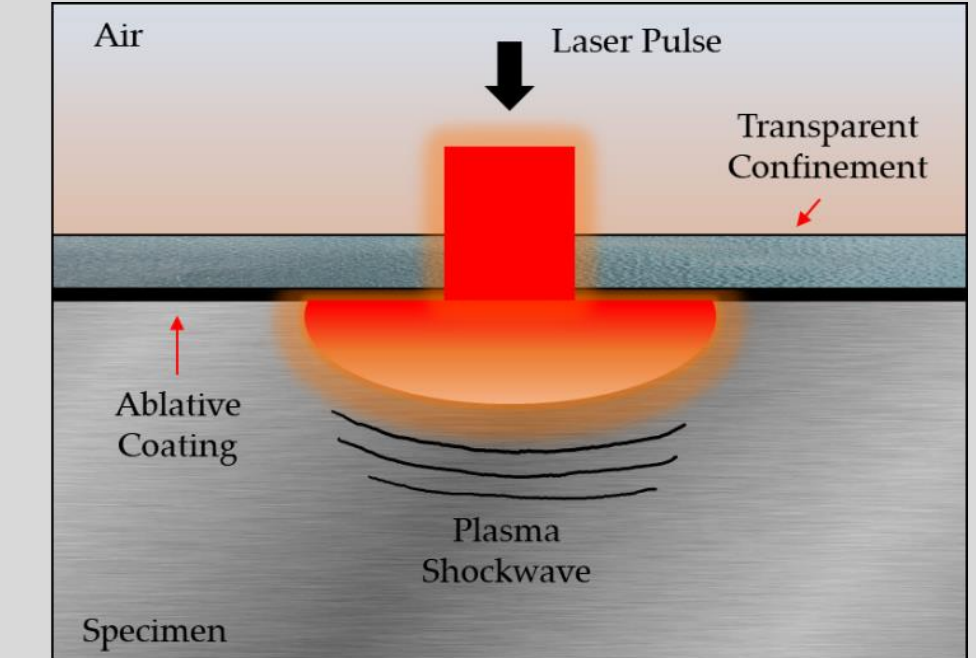


Fig. 2: Tribo-corrosion setup

CS Deposition



Laser Shock Peening



Robust CS Deposit



Results and Discussion

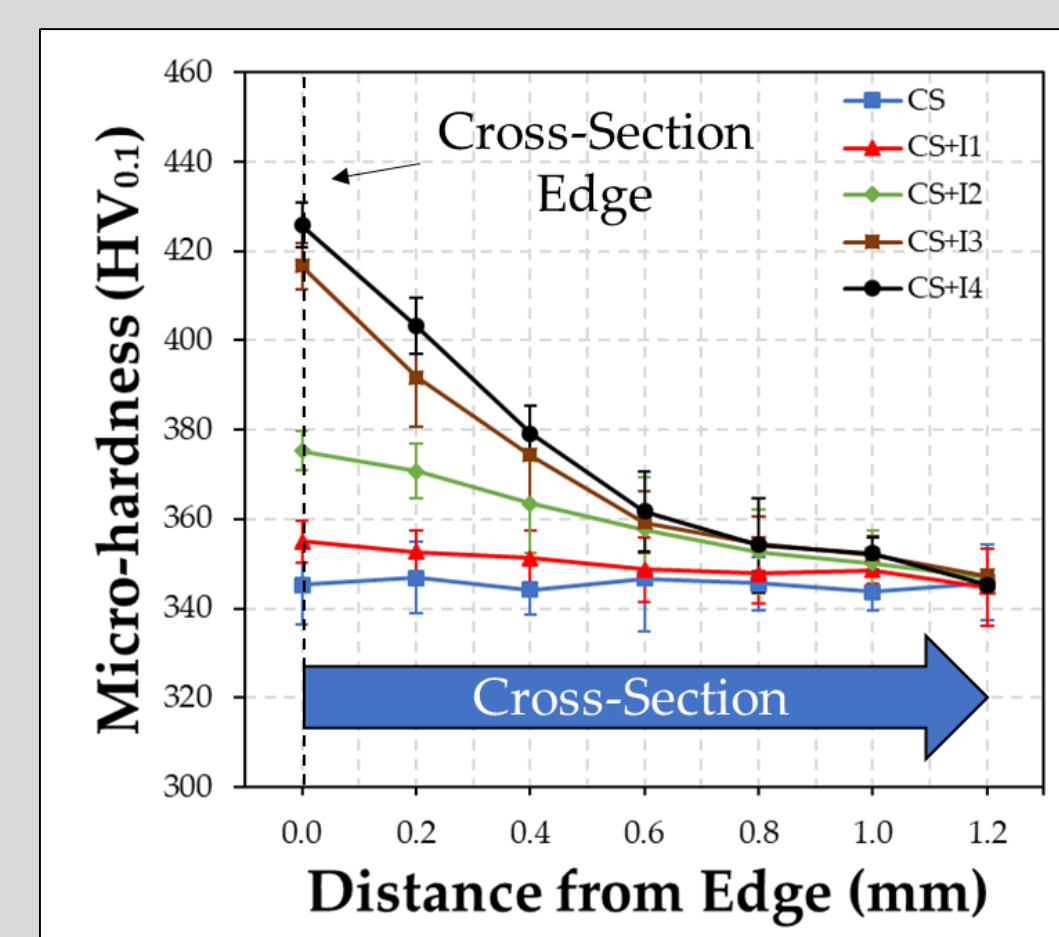


Fig. 3: The cross-sectional hardness of tested specimens.

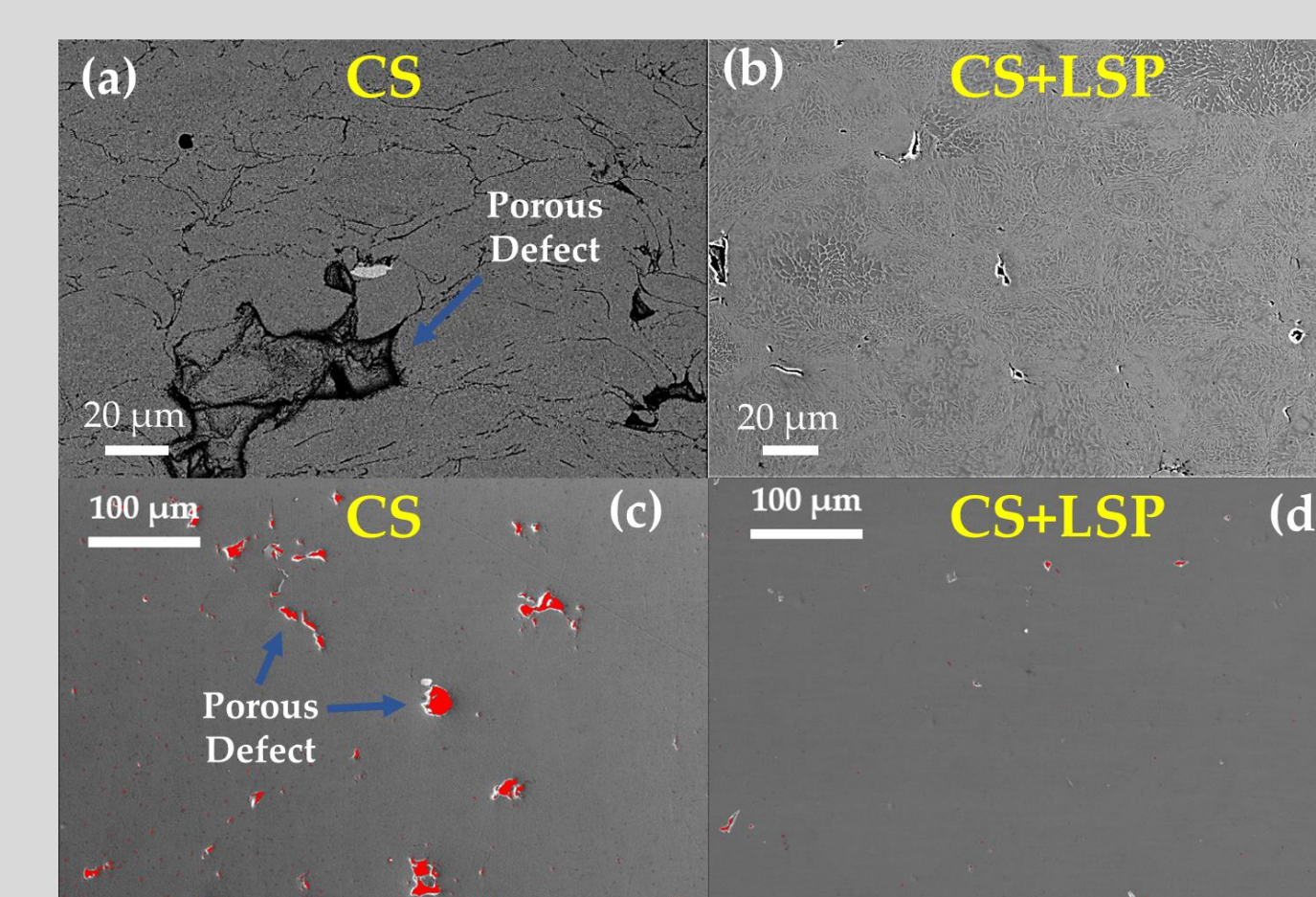


Fig. 4: Surface morphology and microstructure of the CS (a,c) and CS+LSP (b,d) substrates

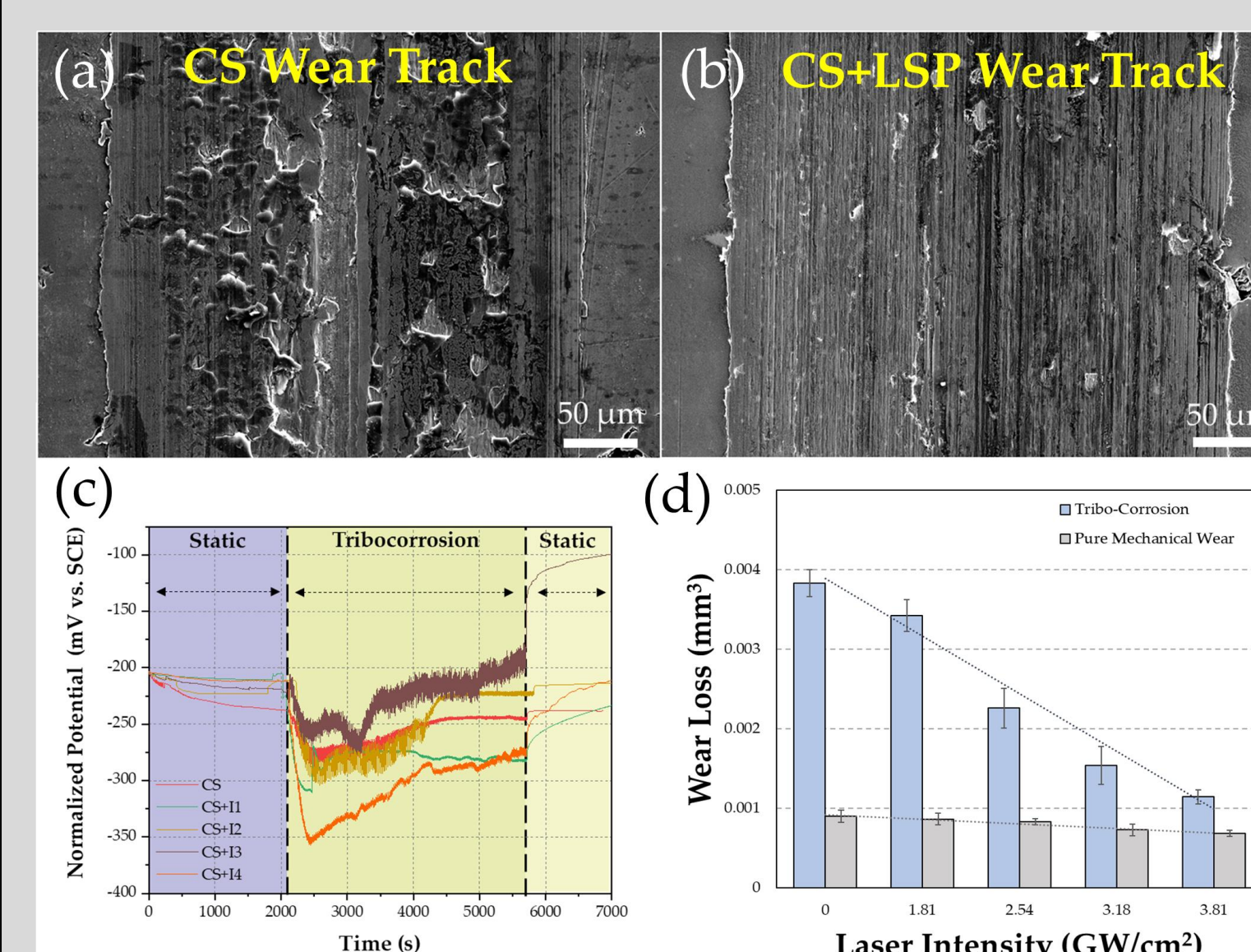


Fig. 6: Wear track morphologies of the (a) CS and (b) CS LSP specimens, alongside the change in (c) open circuit potential and their (d) wear loss.

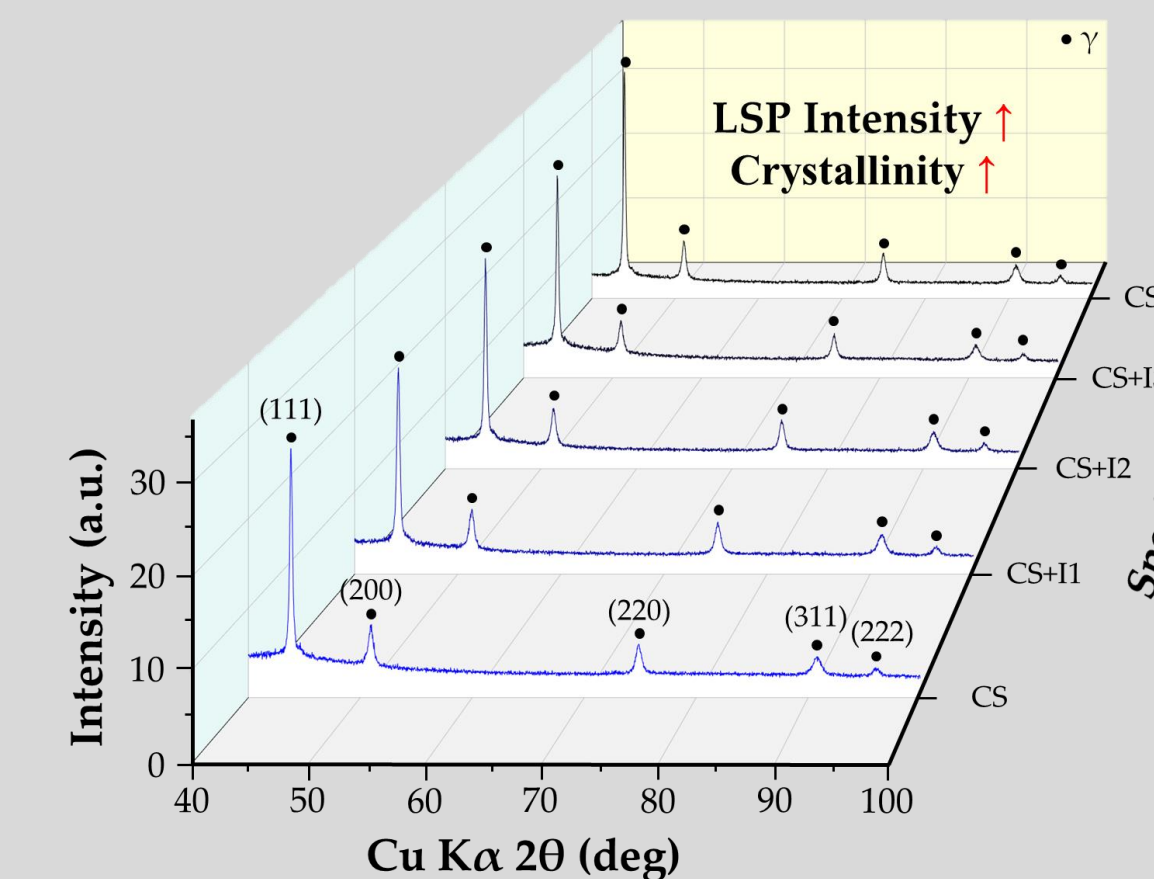


Fig. 5: XRD spectra of tested specimens.

Refined Microstructure
Dense and Robust Surface
Improved Hardness

Results and Discussion

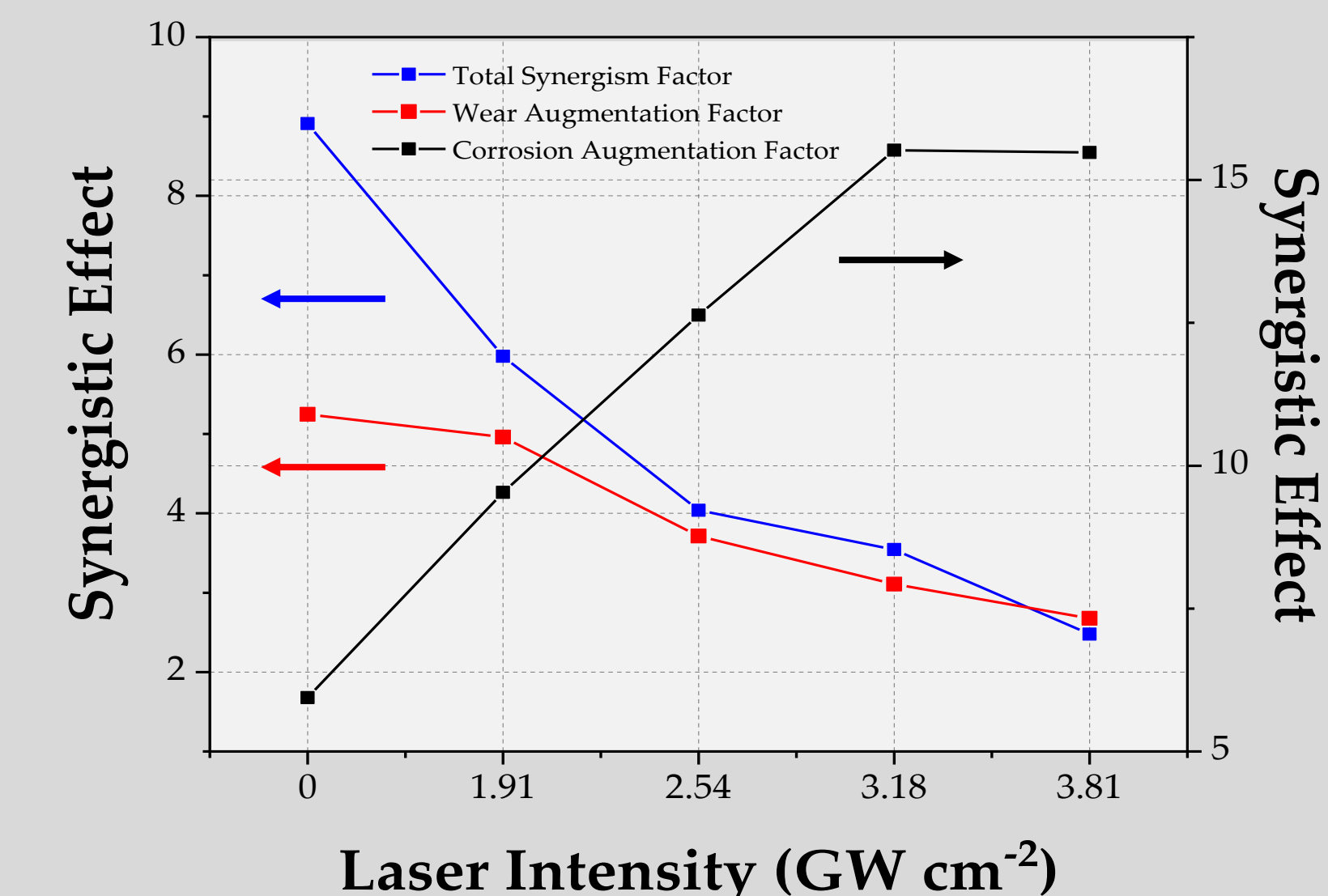


Fig. 7: Tribo-corrosion synergism model

Reduced Wear-Corrosion Synergism
Improved Degradation Resistance

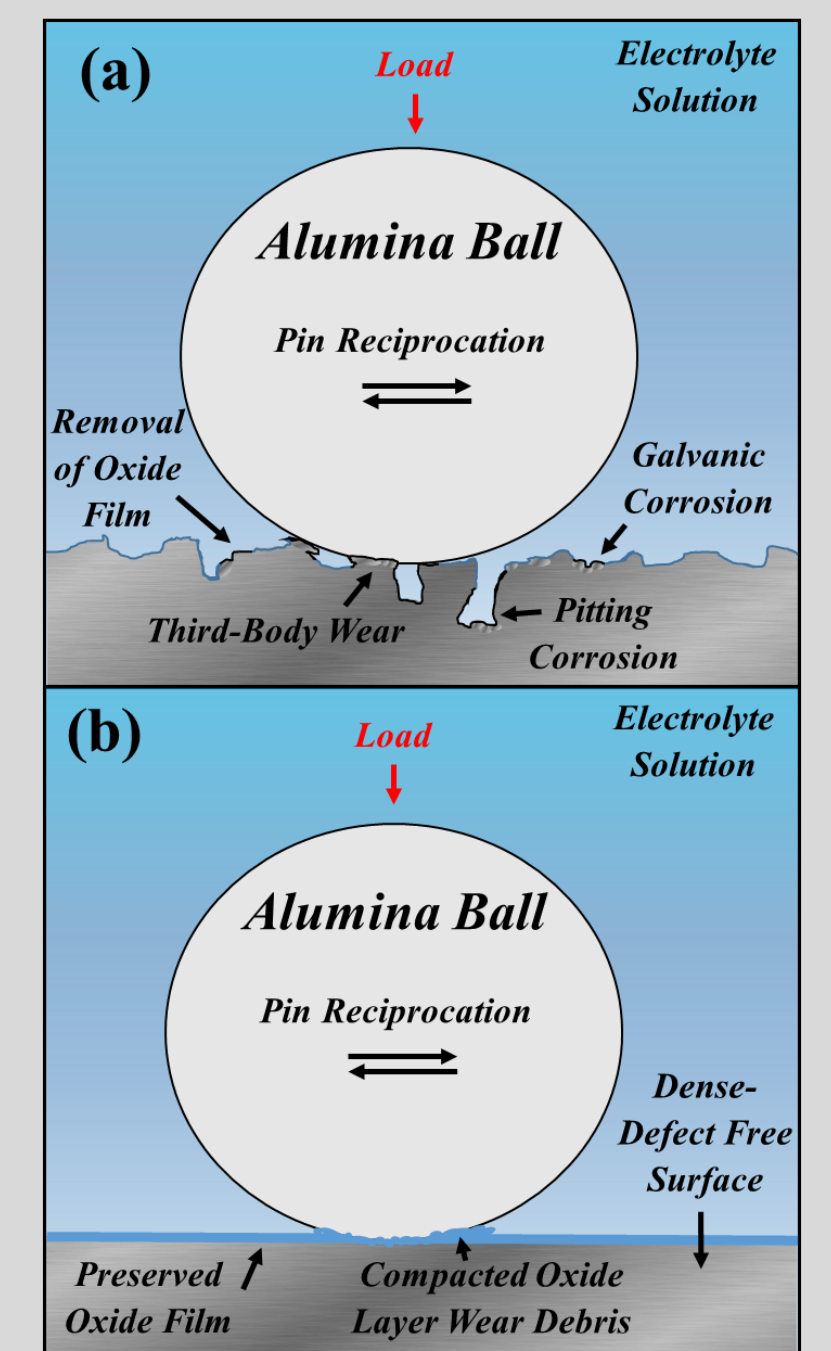


Fig. 8: Tribo-corrosion mechanism

Implications for Mars Travel



Component Degradation Can Be Controlled
Reduced Machine Downtimes
Greater Preparedness and Safer Exploration

Conclusions

- LSP improved the atomic, microstructural, and physical features of CS steel
- Tribo-corrosion synergy decreased due densified and strengthened surface
- LSP-processing allowed for greater degradation resistance, providing to be a reliable technique for Mars exploration

Acknowledgements

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