STRUCTURAL INTEGRITY OF COLD SPRAY REPAIRED ALUMINUM 7050 COMPONENTS

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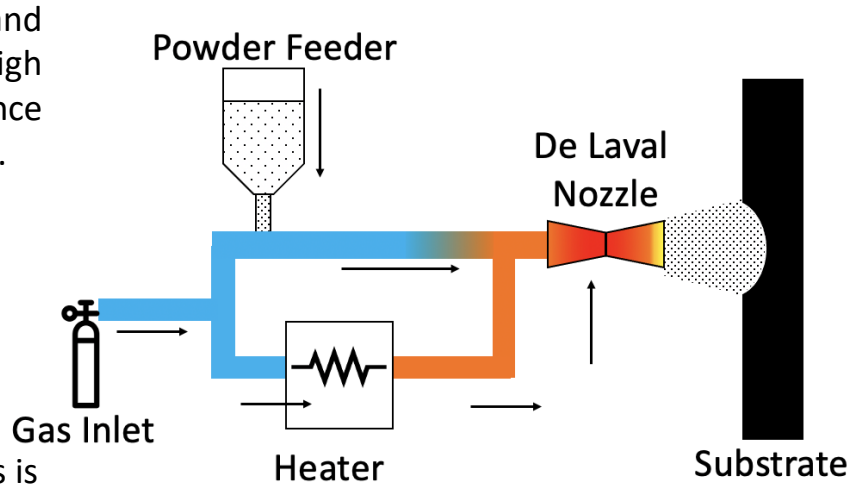
Background and Motivation

Aluminum alloys are widely used in the aerospace and automotive industries owing to their low density and high tensile strength. During their service life they experience damages because of wear, corrosion, cyclic or static loading. Cold spray (CS) has been used to repair damages in high-performance alloys. It is a solid-state material deposition process during which the temperature stays below the melting point, so the negative effect of high-temperature processes, such as oxidation, high thermal stress, etc., are avoided.

However, the mechanical performance of the repaired parts is a significant concern. Also, a systematic understanding of the structural integrity of the repaired parts and a standard repair methodology are still missing in the open literature.



[adapted from (Yin et al.)]

Damaged

Repaired

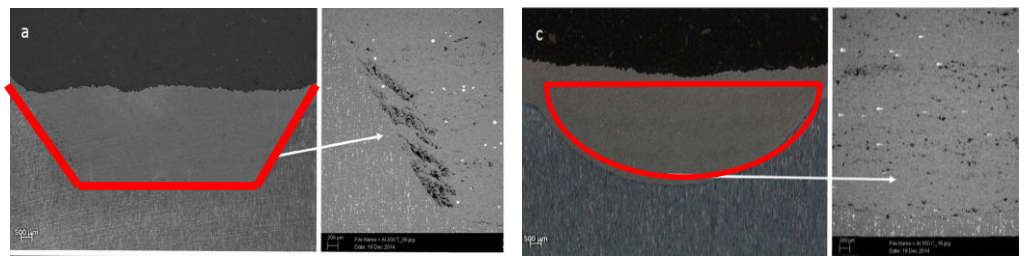
[taken from (Yin et al.)]

State-of-the-art

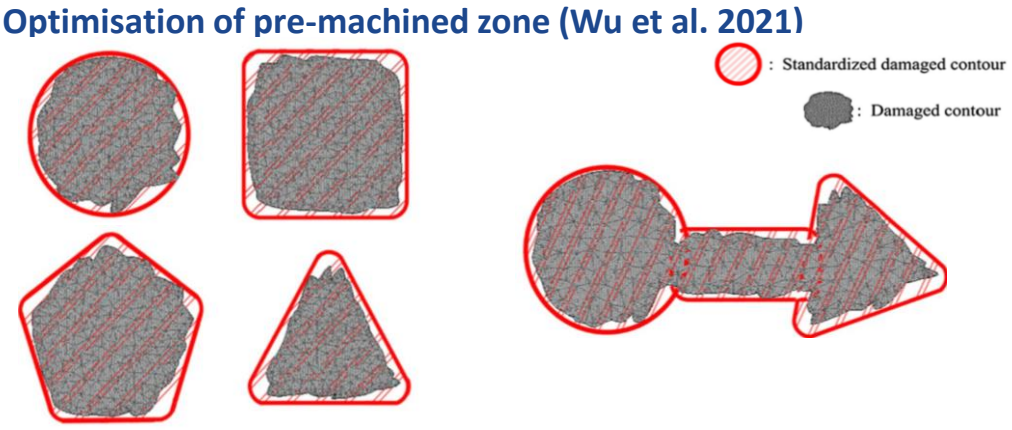
- Fine microstructure (cold spray deposited AA7050)
- Low porosity (<1%)
- Cold working, which is inherent to the process, results high UTS but low ductility
- Ductility can be enhanced with heat treatment (HT), but HT has a negative impact on fatigue strength due to RS relief
- Compressive residual stress arises after the process that has a positive effect on fatigue performance
- Fatigue performance of repaired components depends on repair material, pair design and residual stress distribution

Recent trends and relevant studies

Effect of pre-machining shape on porosity (Moridi 2015)



Optimisation of pre-machined zone (Wu et al. 2021)



Effect of layer thickness on mechanical performance (Rech et al., 2014)

Key Objectives

- ❑ Studying the effect of process parameters on residual stress distribution
- ❑ Investigating the effect of process parameters on fatigue performance
- ❑ Determining the effect of pre-heat treatment on mechanical performance of cold spray repaired components

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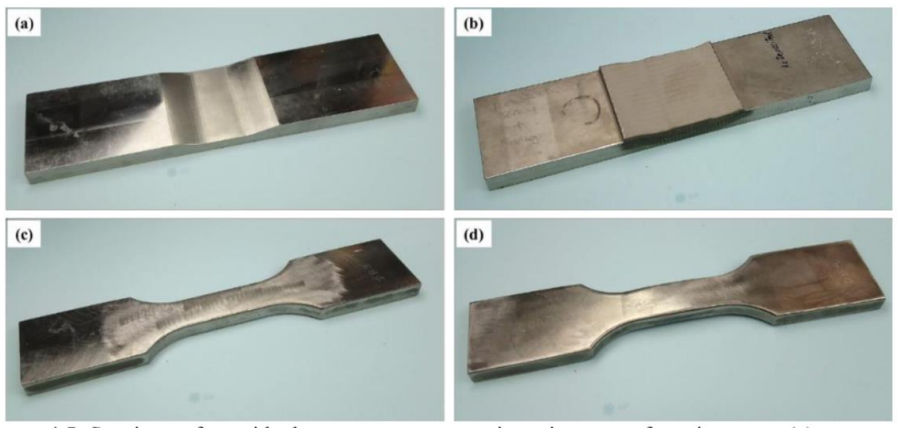
Research Framework

Cold Spray Repair Process

Specimen Preparation (Boruah,2020.)
To have a representative specimen for testing CS repaired parts, the middle part of the specimen is machined, and the grind-out region is filled with cold spray.



In order to achieve process aim following experiments will be performed during the project

Microstructure analysis	Tensile properties
Residual Stress	Hardness
High Cycle Fatigue	Fracture Toughness
Fatigue Crack Growth	

Acknowledgments

This publication was made possible by the sponsorship and support of Lloyd's Register Foundation. The work was enabled through, and undertaken at, the National Structural Integrity Research Centre (NSIRC), a postgraduate engineering facility for industry-led research into structural integrity established and managed by TWI through a network of both national and international Universities.

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