Design of sustainable metal-composite joints with hierarchical surface features for improved bonding and fracture toughness

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HYPER (HYbrid PEnetrative Reinforcement)

- Airbus Patented, WO2008110835A1
- To be produced by AM
- No design limitation
- Suitable for Long Fiber Composites

References:

- 2014 - Static strength of metal-composite joints with penetrative reinforcement
- 2012 - Growth of damage in additively manufactured metal-composite joints
- 2008 - WO2008110835A1
Penetrative Reinforcements and SMC
An improved design application for short fiber composites with infiltrative reinforcements
Design and manufacturing of metal samples
Preliminary mechanical characterization (compression)
Mold & prepreg preparation for infiltration

Orthogonal configuration

Parallel Configuration
Infiltration process & sample preparation

$AF_{10} = 96\%$

$AF_{5} = 82\%$
Qualification of infiltration process

Parallel configuration – Large grid
Qualification of infiltration process

Parallel configuration – Fine grid
Qualification of infiltration process

Orthogonal configuration – Large grid
Qualification of infiltration process

Orthogonal configuration – fine grid
Pull-out test: Sample preparation and Setup
Pull-out test: Results

- Up to 10 times increase of pullout opening pressure force
- Up to 80 times increase of pullout fracture energy
Fractographic analysis
Fractographic Analysis
Fractographic Analysis

- Crack direction change
- Fiber bridging
- Fiber pull out
- Multiple failure modes
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