

# ***An Overview of Laser Surfi-Sculpt® Development***

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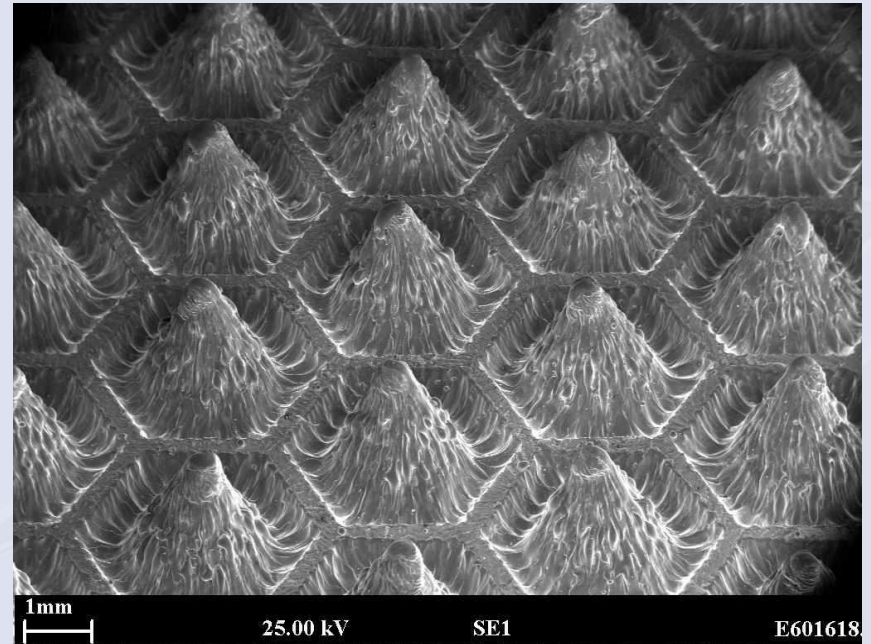
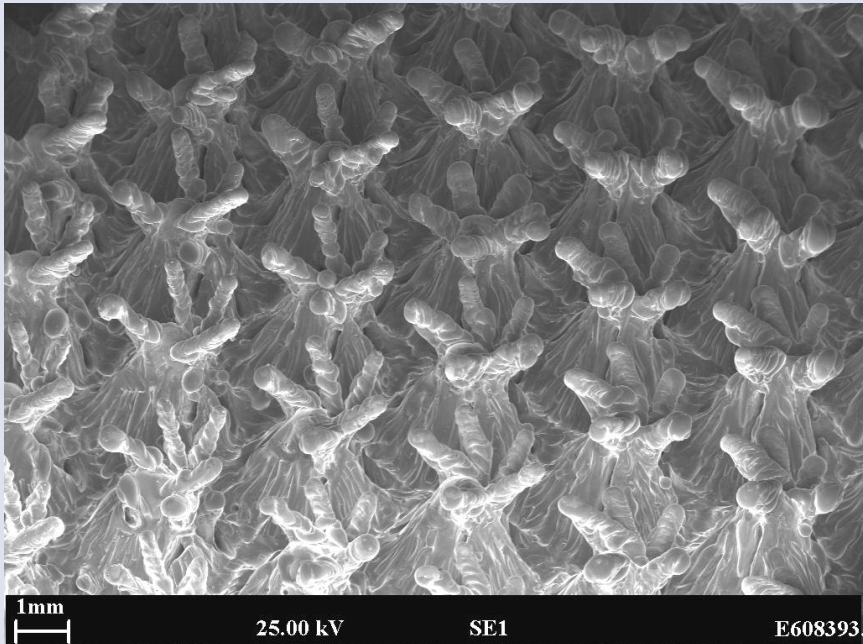
# ***Presentation Overview***

- **The Surfi-Sculpt Process**
- **Key underpinning technologies**
- **Laser Surfi-Sculpt development**
- **Emerging Industrial applications**
  - **Composite to metal joining**
- **On-going research**
- **Summary and Acknowledgements**

# ***Surfi-Sculpt***

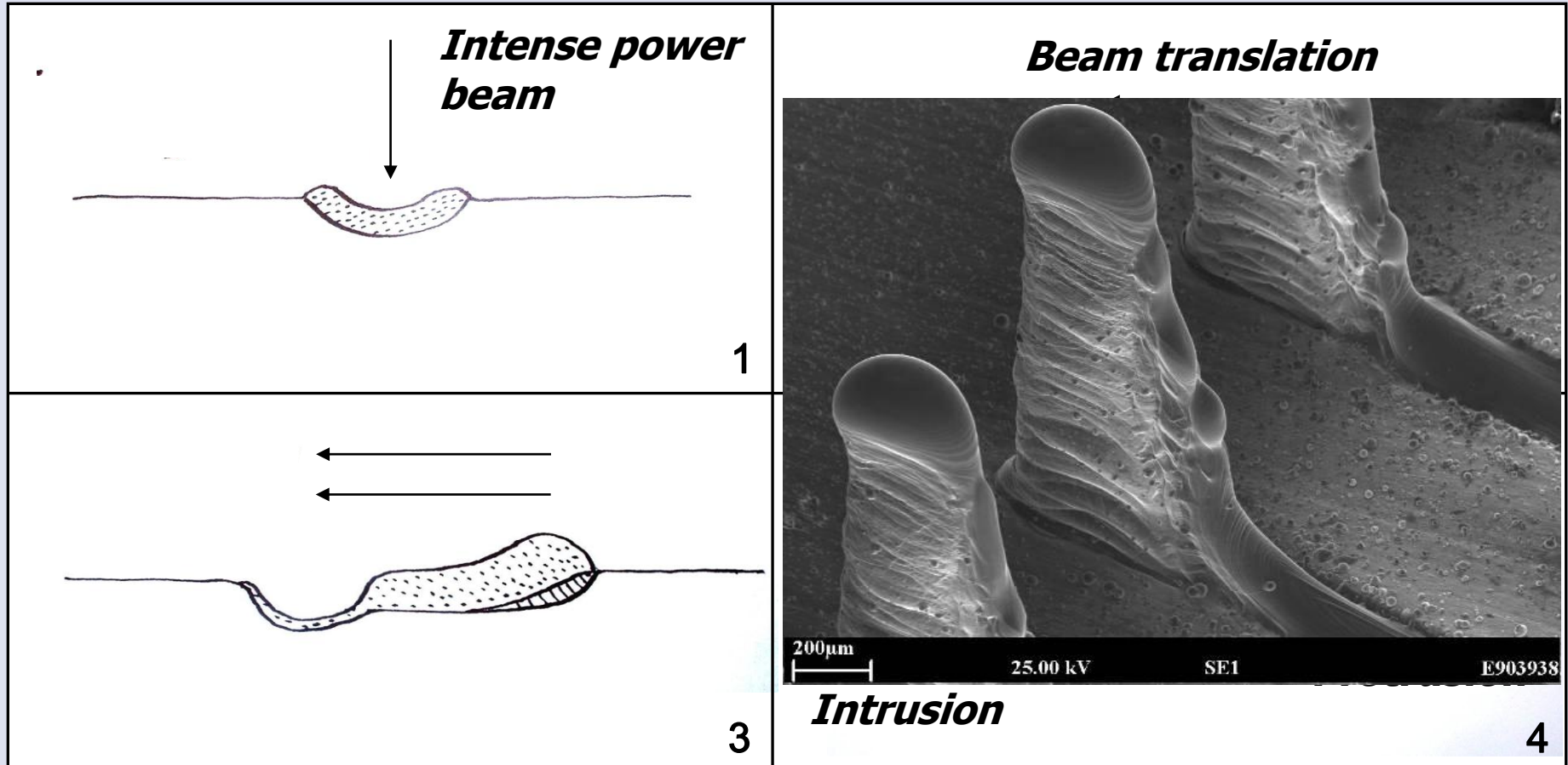
- **Non-additive power beam texturing process**
  - Fusion weld able metallic materials
  - Thermoplastic and selected ceramics
- **Material movement is induced by rapid beam movement; displacement, not ablation**
- **Originally demonstrated with electron beams in early 2000s**
- **First demonstrated with laser beams in 2007**
  - High power, multi-mode 1 $\mu$ m wavelength sources

# *Surfi-Sculpt Features*



Example features produced by electron beam Surfi-Sculpt

# Surfi-Sculpt - Process Overview



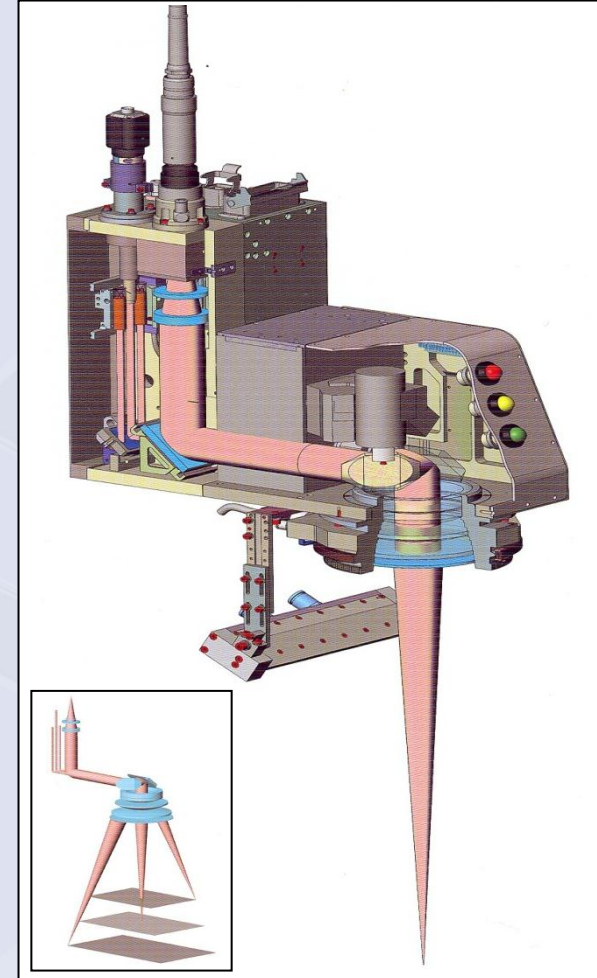
# ***Surfi-Sculpt – Process Overview***





# ***Key Underpinning Technologies***

- **Excellent beam quality laser sources**
  - Enabling high power densities and long stand-off distances
  - Yb-fibre, Yb:YAG disc, CO<sub>2</sub>
- **Galvanometer driven beam scanners**
  - Of the type developed for 'remote' welding
  - Translation speeds of 0.5m/s or more

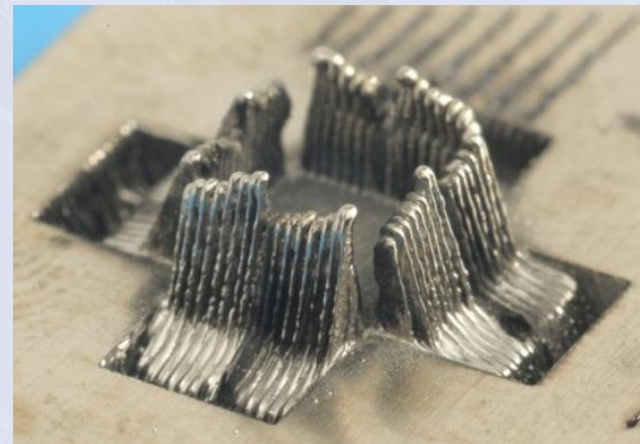
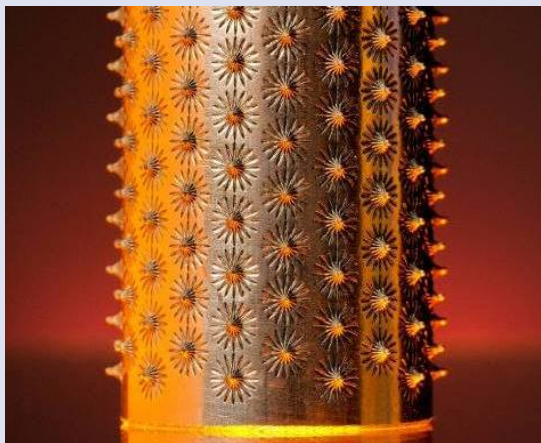
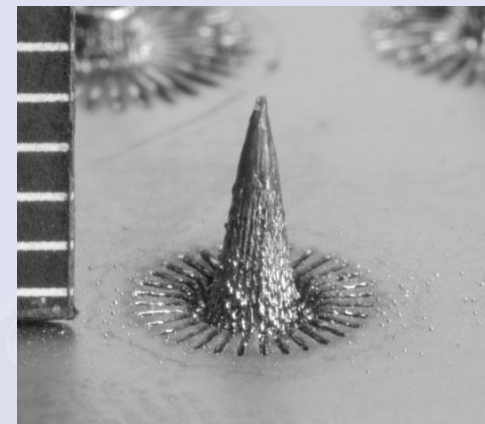
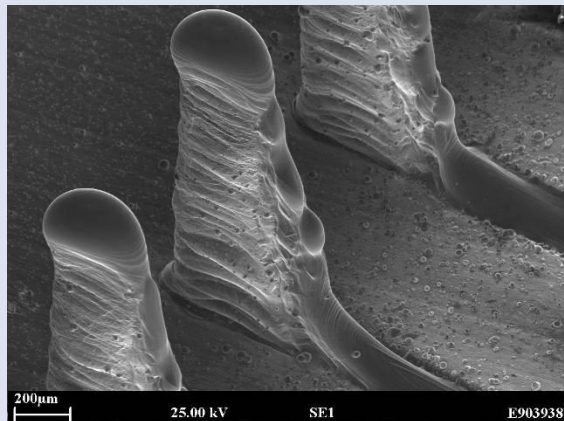


# ***Development Overview***

- **Motivation: enable the Surfi-Sculpt process to be performed out of vacuum**
  - Reduced system cost, increased industrial applicability for large parts etc
- **Equipment**
  - Multi-kW, multi-mode fibre and disc laser sources (up to 2kW output power)
  - 200W single-mode Yb-fibre laser
  - Range of 2D and 3D Galvanometer scanners
- **Parameter optimisation sequence**
  - Single protrusions
  - ↓ Features; several protrusions integrated into a feature
  - ↓ Arrays of features

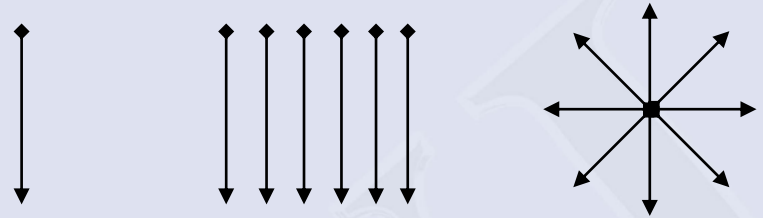


# Laser Surfi-Sculpt®

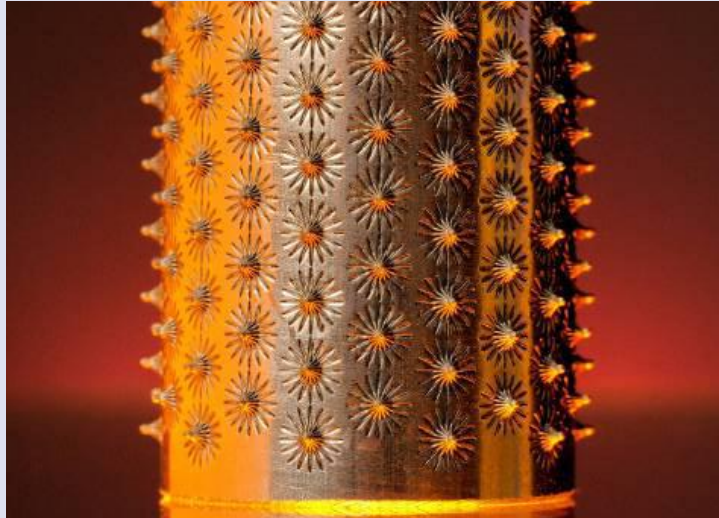


# Key Findings

- **Important parameters:**
  - Power density
  - Swipe speed
  - Swipe delay
  - Number of swipe repeats
- **Readily available laser marking equipment is capable of performing laser Surfi-Sculpt**
- **Will require specialist software to achieve high laser utilisation rates**
- **Management of workpiece temperature is critical to achieving process efficiency**



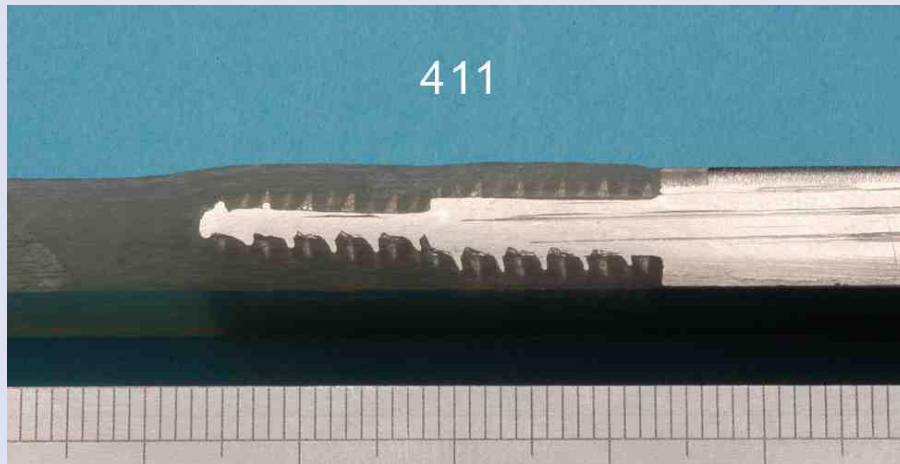
# ***Emerging Industrial Applications***



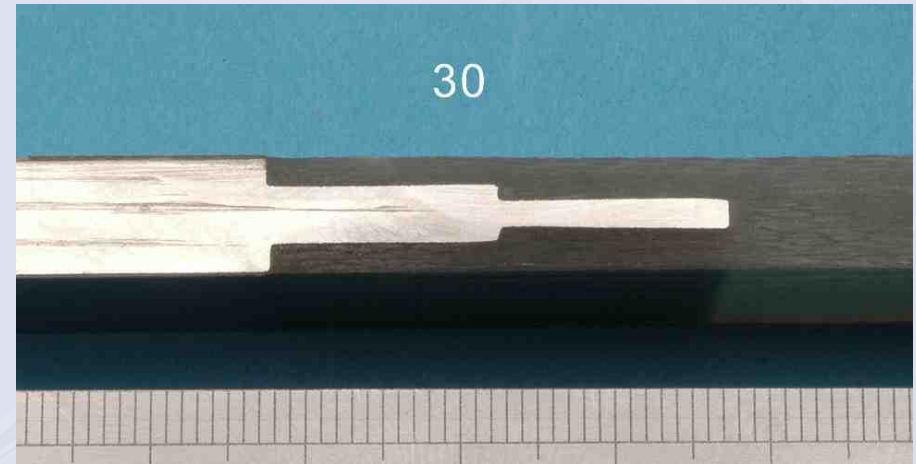
- **Orthopaedic implants**
  - Promoting bone growth
- **Heat exchangers**
  - Increasing heat transfer
  - Turbulent flow in fluidic devices
- **Composite to Metal joining**
  - Load transfer

# ***Composite to Metal Joining***

**Comeld™ joint**



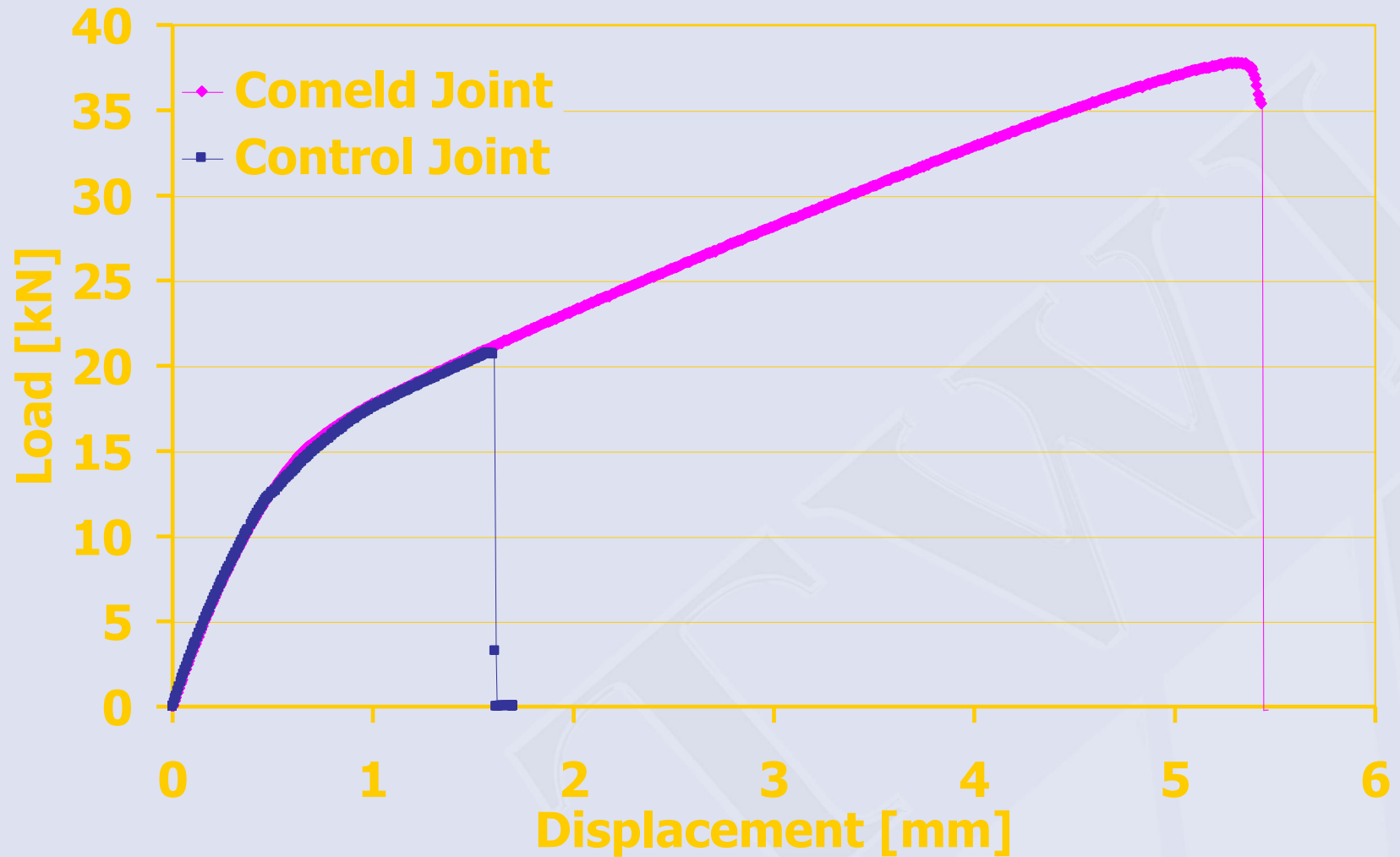
**Control joint**



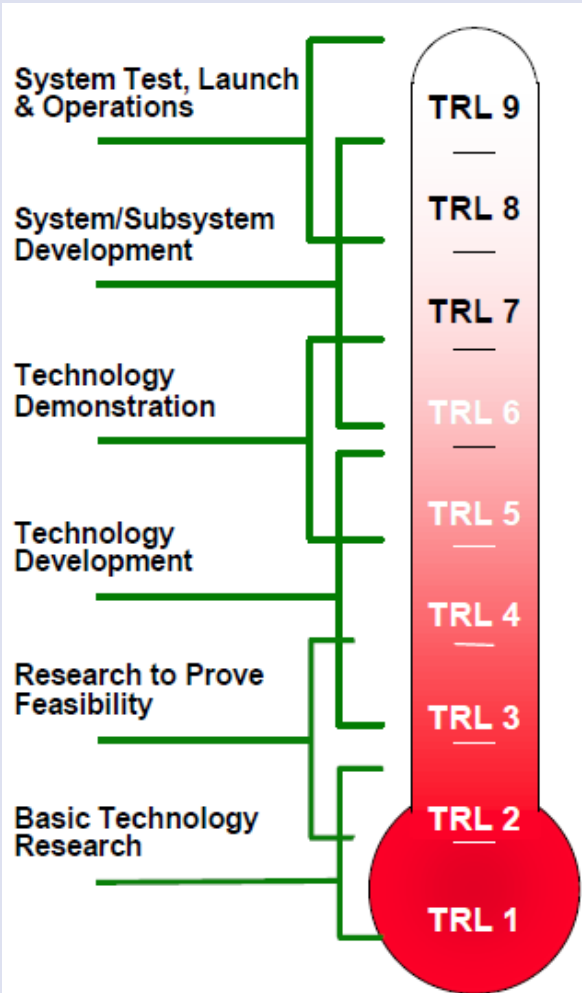
**Stainless steel/GFRP joint made by vacuum infusion**  
**Note: stainless steel treated by EB Surfi-Sculpt**



# Tensile Test Results



# On-Going Research



- Laser Surfi-Sculpt is ~ TRL 3-4
- Necessary equipment is industrially accepted
- Performance and economic data required
  - Non-sculpted surfaces
  - Competing techniques (eg Cold Metal Transfer Pin, mechanical fastening)
- On-going iCASE studentship with IfM

# ***Summary***

- **Laser Surfi-Sculpt has developed at moderate pace since first demonstrated in 2007**
- **Wide array of features produced**
- **Management of workpiece temperature critical for feature arrays**
- **Development on-going**
- **Interested end-users emerging**
  - **Functional performance data required**
- **Process is at TRL 3-4**
  - **Necessary equipment is industrially accepted by other industry sectors**



# ***Acknowledgements***

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# Thank you for your attention!

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