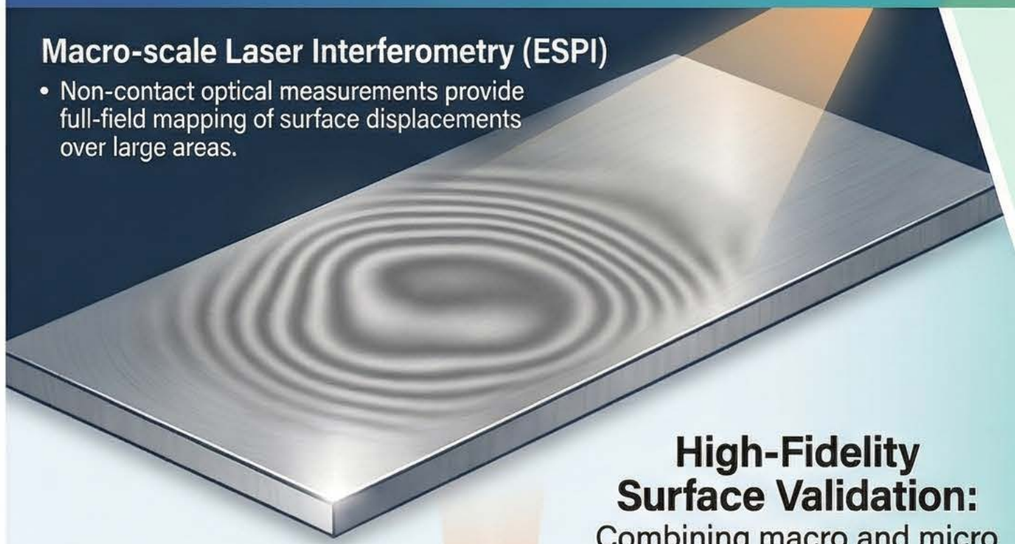
Stress Mapping in Titanium Alloys: A Multimodal Approach

A hybrid experimental-computational methodology for evaluating surface and volumetric residual stresses in Ti-6Al-4V plates.

Phase 1: Surface Stress Characterisation

Macro-scale Laser Interferometry (ESPI)

- Non-contact optical measurements provide full-field mapping of surface displacements over large areas.

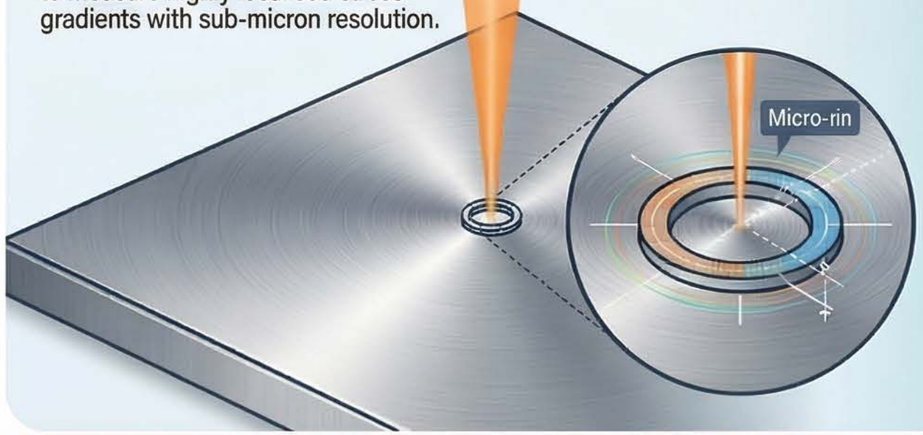


High-Fidelity Surface Validation:

Combining macro and micro techniques ensures a reliable experimental foundation for numerical model calibration.

Micro-scale Ion-Beam Relaxation (FIB-DIC)

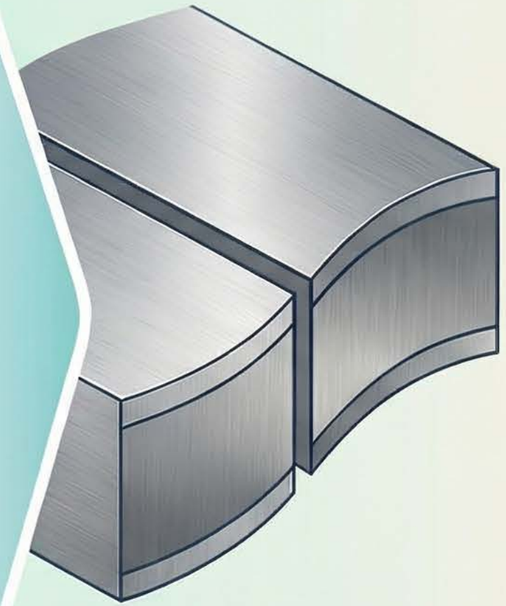
Focused ion beams mill micro-rings to measure highly localised stress gradients with sub-micron resolution.



Phase 2: Through-Thickness & Volumetric Analysis

The Cross-Section Warp Method

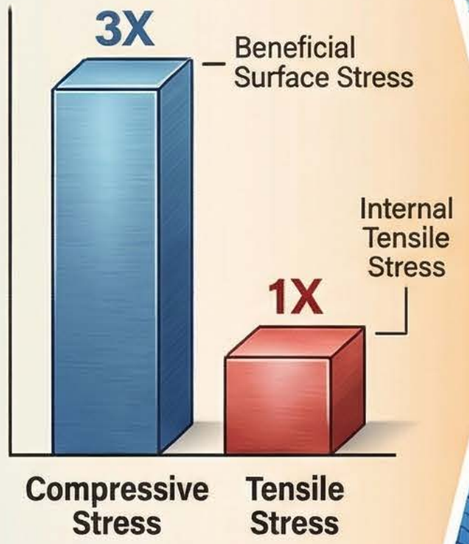
- Deforming forces are revealed by measuring the physical warping of a sample after a precision cut.



Key Parameters & Material Properties	
Applied Dimpling Load:	**13 kN**
Target Dimple Depth:	**1 mm**
Material Yield Strength:	**950 MPa**

Compressive vs Tensile Equilibrium

Dimpling creates beneficial surface compressive stresses nearly three times higher than the internal tensile stresses.



Validated Predictive Modelling

- Finite Element Modelling (FEM) accurately prodicts how indentation depth and diameter influance internal structural performance.