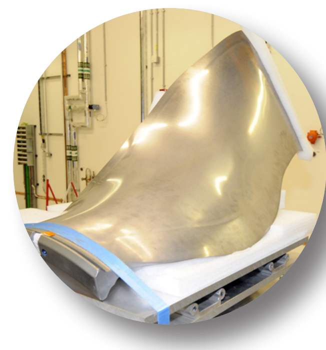
Case Study

Non-destructive strain measurement of a Trent 1000 fan blade

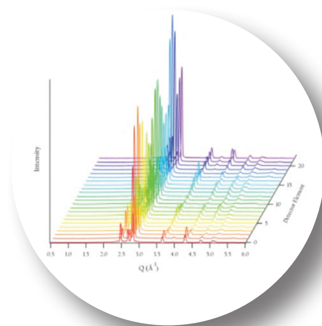
The Problem

Rolls-Royce apply a surface treatment to the base of the fan blades on some of their Trent engines to provide additional integrity margins by reducing the potential for initiation and propagation of cracks. During development of one of their latest turbofan engines, the Trent 1000, researchers from Rolls-Royce needed a material characterisation method so that they could assess the effectiveness of the local surface treatments.



The Challenge

Rolls-Royce engineers needed to quantify the depth and magnitude of the compressive stresses induced by the treatment to understand how effective it is. Although measurements of residual stress in components are routinely performed, these laboratory based methods involve machining metal away prior to taking measurements and then correcting for the metal removal. An alternative nondestructive method was needed to allow high resolution measurement of these compressive stresses in a large sample like a complete fan blade.



The Solution

The team of researchers from Rolls-Royce and Diamond used energy dispersive X-ray diffraction on beamline I12 to investigate the effectiveness of local surface treatment. The beamline provides a unique facility for measuring internal stresses and strains of components up to 2 tonnes in mass and beyond 1 metre in length in a non-destructive manner.

The Benefits

The diffraction measurements at Diamond enabled Rolls-Royce to look effectively inside the fan blade and measure through-wall residual stresses. The measurements were shown to be less time consuming and more accurate than laboratory based methods and, perhaps most importantly, the non-destructive method allows further use of the components.

"The information we can now obtain from I12 will help us develop new processes, improve material properties and reduce cost. This detailed, in situ examination of advanced engineering materials will enhance the durability of aerospace components."

Prof David Rugg, Rolls-Royce

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