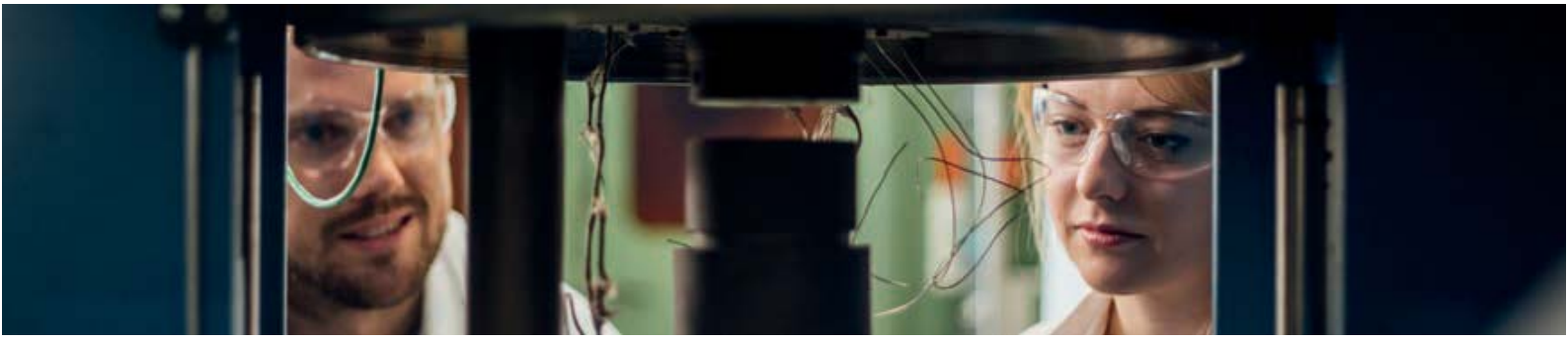
HENRY ROYCE INSTITUTE

The University Of Sheffield.

SWARF TITANIUM TO ENGINE PARTS IN 3 STEPS

CREATING A STEP-CHANGE IN THE ECONOMICS OF TITANIUM

FAST STEP 3 (Field Assisted Sintering Technology for Swarf Titanium to Engine Parts in 3 steps) is a £1.8M collaborative research and development project - part-funded by Innovate UK - to reduce the cost of titanium alloy components. Lower-cost access to lightweight titanium alloys will be a game-changer for the automotive industry, enabling manufacturers to reduce the emissions their cars create, while keeping them affordable.



The automotive sector does not routinely currently use titanium alloys, due to the significant associated costs. However, the sector faces ever-increasing challenges in meeting emission targets and reducing vehicle mass. Titanium alloys can be part of the solution to these challenges, if the cost can be reduced.

In the coming decades the aerospace sector will generate vast and increasing quantities of titanium alloy swarf, which is effectively a waste product. The FAST STEP 3 project will show it is possible, with appropriate cleaning and grading, to recycle this waste swarf as a feedstock for the FAST-*forge* process (developed at The University of Sheffield) to produce near-net-shape parts that are then lightly machined into finished components. This combination of low-cost feedstock with cost-effective processing means affordable titanium alloy components will become a reality.

Access to equipment provided by the Henry Royce Institute is proving vital for this project: the small-scale FCT FAST furnace and the new large-scale semi-continuous FAST furnace are being used extensively.

The aim is to produce titanium alloy components at 20% of the current cost, and with minimal wastage.

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CONTEXT

Global air traffic is expected to increase by 4.7% per year between now and 2035. This represents a doubling in the number of aircraft needed in the next 15 years, which means over 35,000 new passenger planes will be required. The use of titanium alloys in the commercial aerospace sector has also increased; from ~15t to ~30t per aircraft in the last 20 years. However, manufacturing of aerospace titanium components can generate substantial material wastage, up to 70%, mostly as swarf/turnings from machining processes.

RESULTS

The FAST STEP 3 project will manufacture and functionally bench test 4 engine components of increasing complexity, from both a manufacturing and performance perspective, with the strength/fatigue properties required in automotive applications.

The aim is to demonstrate the production of titanium alloy components at 20% of the current cost and with minimal wastage. Longer term, titanium alloy automotive components will provide prestige to high-end vehicles, reduced fuel consumption and emissions, decreased energy use for manufacturing, and a beneficial life-cycle analysis through recycling a waste product.

The FAST STEP 3 project also aims to develop a new UK supply chain to exploit this technology; allowing diversification for companies within the traditional metal manufacturing sector.

IMPACT

This project is about developing a new disruptive manufacturing process and a new UK-based supply chain, securing UK IP from raw material to end product. This will be the first demonstration of recycling titanium alloy swarf into high-value automotive engine components. It will assist the automotive sector to achieve cost-effective lightweighting for automotive engines to lower emissions (CO_2, NO_x, particulates), initially for low volumes, with potential to move into higher volumes applications. Automotive production is anticipated to start 3-4 years after the end of the project.

The FAST-*forge* process is highly tolerant of feedstock characteristics and chemistry, and readily adaptable to producing a wide range of shaped billets. This provides growth opportunities and UK job retention for the developed supply chain, not only in automotive, but also in the wider advanced manufacturing sectors of offshore, rail, aerospace, non-automotive engines and defence.

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