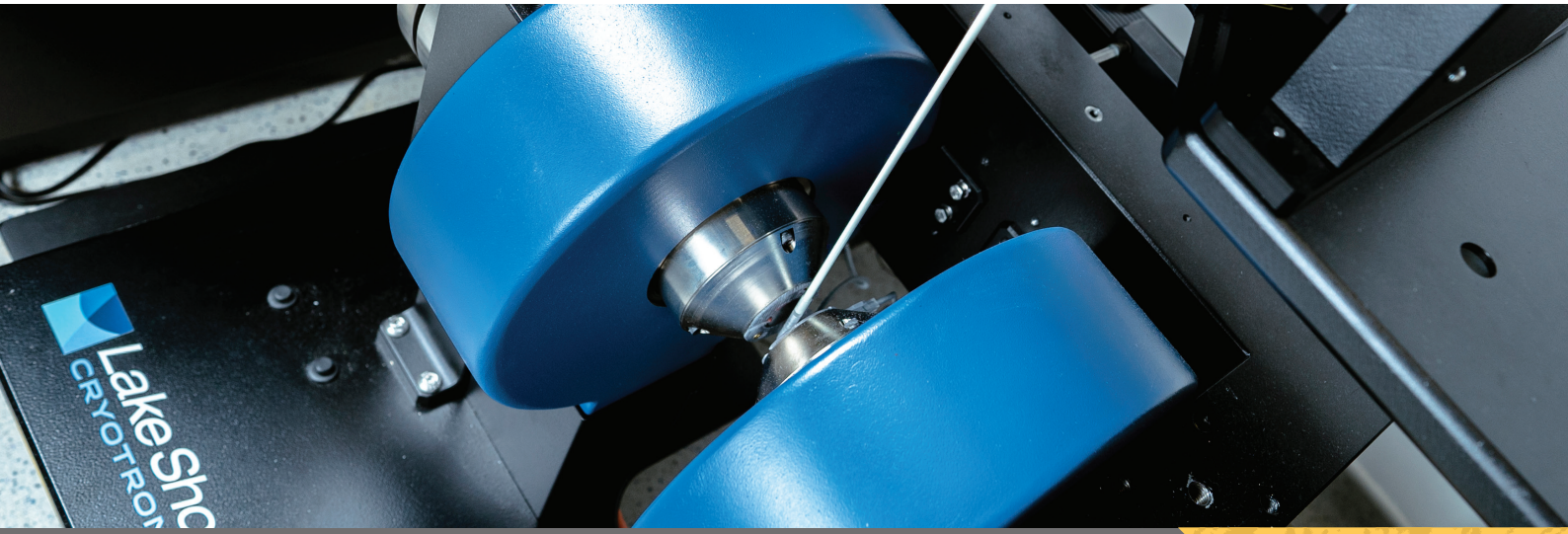
UNIVERSITY OF CAMBRIDGE

ADVANCED MATERIALS RESEARCH & INNOVATION

Investigating additive manufacturing of electrical steels by selective laser melting

Many forms of iron core materials are being used to convert electricity into mechanical power. The use of the Vibrating Sample Magnetometer, part of the comprehensive Royce Physical Vapour Deposition and Characterisation Suite, allowed researchers from the University of Portsmouth to investigate the magnetic behaviour of 5*5*2 mm^3 for use as one of these Iron cores.



Royce Physical Vapour Deposition and Characterisation Facility (PVDCF)

A state of the art facility comprising of versatile equipment for the physical deposition and characterization of novel materials with a thickness in the range of micrometres down to a monolayer. This nanotechnology platform supports the growth of metals and insulator-thin films as well as device fabrication. The facility enables research into energy efficient materials for novel batteries, information and communications technologies and quantum technologies.

Magnetic Characterisation at the PVDCF
Magnetic hysteresis as well as AC susceptibility from 400 K down to 300 mK.

- SQUID magnetometry
- Vibrating Sample Magnetometer magnetometry

ROYCE

University of Cambridge is a Partner of the Henry Royce Institute for advanced materials

THE CHALLENGE

The challenge with research and evaluation of the magnetic properties of soft magnetic materials is the accessibility of VSM units that can analyse small, and thus challenging sample sizes. The sample holder could accommodate the 5*5*2 mm^3 Iron-Silicon sample, which is rare. The Royce VSM was also compatible with the samples in terms of the magnetic saturation and fine calibration it could provide.

Additive Manufacturing of this alloy is widely used in electric magnets for many electromotor devices, also known as electric engines. For example, it forms the magnetic core of electric engines in EV/electric drones. During this project the intention was to investigate the magnetic behaviour of the 5*5*2 mm^3 samples to find the optimized conditions for printing the magnetic parts with the best metallurgical and magnetic properties. Once the best properties are achieved with low manufacturing costs, through Additive Manufacturing (selective laser melting) technology, this alloy could be industrialised and become impactful to the electromotive industry.

"The level of professionalism and expertise from Royce personnel was superb."

RESULTS

During this experiment Babak was able to successfully evaluate the magnetic properties of Fe-Si soft magnetic alloy in terms of B-H diagrams which enabled him to assess and find the best manufacturing parameters for selective laser melting of this alloy. The results are being published in a high impact journal.

Visit **royce.ac.uk/impact** to read more impact case studies from the Henry Royce Institute

Contact **royce@maxwell.cam.ac.uk** to use Royce Cambridge equipment

"During this cooperation with Adrian Ionescu at the Royce VSM in Cambridge, I was able to learn a great deal on how to operate the VSM and also how to analyse the gathered data from it. The level of professionalism and expertise from the personnel was superb and I am looking forward to future cooperation. Considering the special conditions of my samples and my research and with the small sample sizes I had available, I would not have been able to easily perform these experiments without Royce at the University of Cambridge."

Babak Haghighat,
University of Portsmouth