MATERIALS & COMPONENTS

NEUTRON DIFFRACTION ENABLES WING QUALITY TO SOAR FOR AIRBUS

Airbus, a global leader in the aerospace sector, accessed STFC facilities and expertise to assure weld quality in welded aluminium alloys used in aircraft components, and to develop manufacturing techniques.

THE CHALLENGE

Residual stress are those stresses that remain in an object even in the absence of external loading or thermal gradients. Residual stresses sometime remain in a welded structure when some parts of a weld cool and contract more than others, leaving potential weaknesses and the possibility of crack formation.

Residual stresses are often invisible to a manufacturer, unless they result in significant distortion. These stresses can negatively affect structural integrity. However, beams of neutrons can be used to probe deep into the structure of metallic engineering components like aircraft wings.

THE EXPERIMENT

Scientists at ISIS Neutron and Muon Source use neutrons to examine the interior of large engineering components and identify areas of stress that might lead to unexpected behaviour. Neutron diffraction enabled measurement of stress fields in large aircraft wing test panels providing information leading to a better understanding of performance.

The research for Airbus that took place at ISIS focused on the integrity of welds in aluminium alloys, which are often very difficult to weld, and to assess their suitably for future aircraft programmes.

THE RESULTS

The research conducted enabled Airbus to discover areas of potential stress and weakness in its aircraft parts. Airbus engineers were also enabled to adjust manufacturing processes and to make lighter and safer aircraft parts at a lower cost. The process was integral to the development of welding techniques and confirmed the integrity of aircraft parts. This assured the quality of engineering components before the manufacturing process.

> “Residual stress measurement carried out at ISIS has been invaluable in researching and developing existing and novel material manufacturing and processing techniques. The fact that neutron diffraction is a non-destructive technique means it can even be used to improve component performance in manufactured parts.”

Richard Burguete

Structures Test Programme Manager
R&T, Airbus

INDUSTRIAL APPLICATIONS OF NEUTRON SCIENCE

LENS LEAGUE OF ADVANCED EUROPEAN NEUTRON SOURCES

For decades, European neutron facilities have established productive collaborations with a diverse range of industrial users. Such partnerships have delivered important results for industry, providing insights into materials and methods that have driven process optimisations and technological innovations.

WHY USE NEUTRONS?

STUDY STRUCTURE

Neutron wavelengths are are comparable to the spacings of atoms and molecules.

STUDY DYNAMICS

Neutron energies are comparable to the time scales of molecular diffusion, vibrations and rotations.

STUDY MAGNETISM

The neutron's magnetic moment can be used to study the microscopic magnetic properties of materials.

PENETRATION POWER

Neutrons can penetrate deep into matter (including many different metals) enabling the study of large samples - even within complex sample environments.

NON-DESTRUCTIVE

As a non-destructive, non-invasive probe, neutrons are suitable for the characterisation of delicate and precious samples.

VERSATILE SAMPLE ENVIRONMENTS

Sophisticated sample environments enable measurements under operating conditions - including extreme temperatures, pressures, etc.

SENSITIVITY TO LIGHT ELEMENTS

The neutron scattering power of nuclei varies in a quasi-random manner such that lighter atoms (e.g. H, Li) can be studied in the presence of heavier ones.

ISOTOPIC CONTRAST

Neutrons are sensitive to different isotopes of the same element, so isotopic substitution (e.g. H/D) can be used to highlight specific structural features.

COMPLEMENTARITY

Neutron scattering is highly complementary to other techniques, such as X-ray scattering, electron microscopy, magnetic resonance and computational methods.

HOW CAN INDUSTRY USERS GET ACCESS TO NEUTRON FACILITIES?

European neutron facilities provide industrial users with access to advanced instrumentation for R&D. No prior experience is needed – expert scientific and technical staff provide support for users to get the most from their experiments.

Neutron facilities offer a variety of mechanisms to access their infrastructure, including proprietary access, academic partnerships and public beamtime.

For more information, email contact@lens-initiative.org