The European Synchrotron Radiation Facility

The ESRF operates exceptional facilities and expertise for **advanced materials characterisation**.

The world-leading synchrotron X-ray facilities of the ESRF allow the advanced analysis and characterisation of materials, **going far beyond those possible using traditional laboratory techniques**. Synchrotron light is a flexible, precise and non-destructive method for learning about the structure and behaviour of materials from the atomic to macroscopic level under in situ manufacturing and end-use conditions. We operate mail-in services for synchrotron CT and tomography, powder diffraction, SAXS, protein crystallography, strain imaging, and spectroscopy amongst other techniques.

Our 40 X-ray instruments with technical and scientific support are open for industrial R&D and collaborative innovation:

- **Fast-track paid-for access and services with full IP retention and confidentiality;**
- **Tailored partnerships according to your R&D needs;**
- **Funded studentships and apprentices (e.g. CIFRE, ANR and HORIZON 2020 projects);**

Competitive access by peer review is encouraged for industry able to publish their results.

The European Synchrotron Radiation Facility (ESRF) is a research institute in the heart of the Alps in Grenoble, providing intense synchrotron light for 6,500 scientists from around the world to carry out both fundamental and applied science, and industrial experiments.

ESRF is the centre of excellence for fundamental and innovation-driven research in condensed and living matter science. Located in Grenoble, France, the ESRF owes its success to the international cooperation of 21 partner nations, of which 13 are Members and 8 are Scientific Associates.

The companies that work on materials and process engineering, health, drug discovery and development, catalysis, food and agriculture, energy are just some of the many fields in which industrial R&D can make excellent use of our facilities.

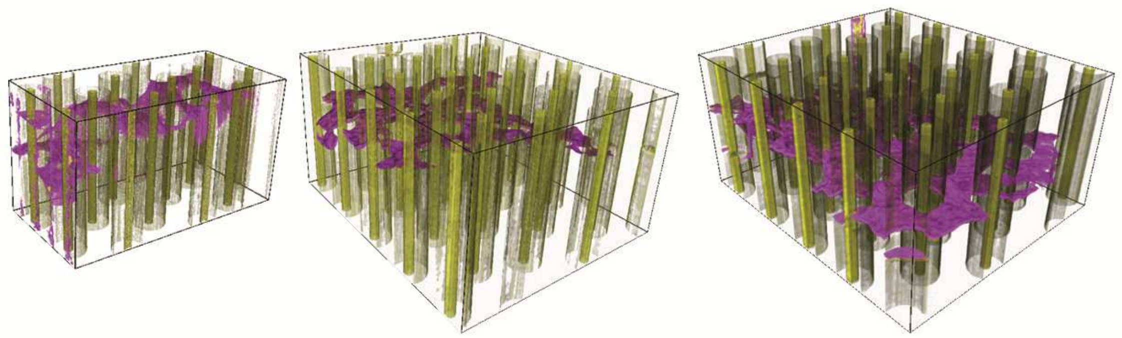
We apply synchrotron X-rays for industrial R&D and materials characterisation whenever details materials and structure understanding is required: materials science and nanotechnology, food science., chemistry, cosmetics, engineering and advanced materials, environment and energy, home and personal care, pharmaceuticals, health and life science.

In 2015 the **ESRF launched its new and final development phase of the Upgrade Programme:** the ESRF Extremely Brilliant Source Programme, or ESRFEBS.
This new programme is revolutionary, and is centred on the construction of a new storage ring that will adopt an all-new hybrid multi-bend achromat lattice design. It will have a normalised horizontal emittance at least a factor of 10 better than any other synchrotron source constructed or presently under construction, and its performances will be a factor of 40 better than the present ESRF storage ring. This new X-ray source is expected to deliver X-ray beams to ESRF beamlines with an increase of approximately 100 times in brilliance and coherence. The EBS programme also includes the construction of new state-ofthe-art beamlines, a scientifi c instrumentation programme with ambitious detector projects and a data management and analysis strategy. An instrumentation upgrade is also planned for several beamlines, including the “national beamlines” operated by Collaborating Research Groups. During this last year, the ESRF has made tremendous progress in the EBS programme by fi nalising the engineering of the new storage ring, reviewing the project costs and spending profi le, preparing and

launching the preprocurement and procurement phases, defi ning the master plan, scheduling the work during the assembly and commissioning phases, and establishing the procedures and planning for the restart of the beamlines.

Case Study for composite materials

STUDYING CRACK PROPAGATION IN COMPOSITES AT HIGH PRESSURES



3D crack-tip microscopy shows a crack (purple) growing in a composite material containing silicon carbide fibres.

Company

University of Mancherster and Rolls-Royce

Challenge

Crack propagation in metallic materials is well understood. But aircraft manufacturers are increasingly turning to more complicated composite materials that are lighter, stronger and can operate at higher temperatures. Lower weight reduces fuel consumption, while higher engine operating temperatures allow aeroengines to be more efficient. The challenge is to understand how cracks propagate in such materials.

Sample

Titanium reinforced with silicon carbide fibres. This composite material can operate at higher temperatures than titanium alone, making it a promising candidate for jet engine parts.

Solution

Synchrotron X-rays penetrate tens of millimetres into a sample where the behaviour of cracks can be very different - this in contrast to eectron microscopy which only reveals the surface features of micro-cracks. On beamline ID15, scientists can use imaging, to see how cracks grow, and diffraction, which tells them about the local stresses that the cracks grow under.

Benefits

The ability to monitor cracks under load at high temperatures allows researchers to evaluate the potential of these materials under realistic conditions. It also helps to make realistic estimates

of the lifetime of existing components and to design safer, more crack-resistant materials for the future.

Better knowledge of crack propagation transfers directly to other industries in which failure is unacceptable, notably the nuclear industry.

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