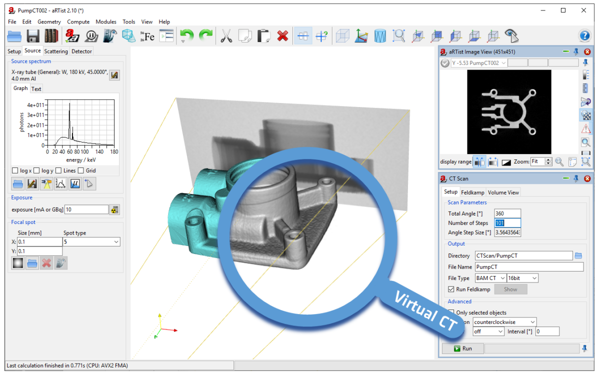
GENERAL DESCRIPTION

We offer a unique palette of experimental techniques to characterize the micro- and meso-structures over a large spectrum of materials (light alloys, steels, ceramics, composites).

We focus on the microstructure-property relationships, linking the 2D and 3D quantitative analysis of defects and internal features to stress distributions and phase-specific mechanical properties.

We use simulation and analysis tools that support the interpretation of our experimental data. We continuously develop solutions for quantitative microstructural analysis.

Finally, we offer comprehensive service to industry and academic partners.



User-friendly interface of the radiographic simulation software aRTist (C. Bellon)

CONTACT PERSON

X-Ray Computed Tomography
Dr. Henning Markötter
✉ henning.markoetter@bam.de ☎ +49 30 8104-4720

X-Ray Refraction Techniques
Dr. Andreas Kupsch
✉ andreas.kupsch@bam.de ☎ +49 30 8104-3692

Stress Analysis (Diffraction)
Dr. Alexander Evans
✉ alexander.evans@bam.de ☎ +49 30 8104-4682

Scientific and technical services
Dietmar Meinel
✉ service-8.5@bam.de ☎ +49 30 8104-4539

Head of Division
Dr.-Ing. Alexander Ulbricht
✉ alexander.ulbricht@bam.de ☎ +49 30 8104-4140

Secretariat
✉ sekretariat-8.5@bam.de ☎ +49 30 8104-1859

Bundesanstalt für Materialforschung
und -prüfung (BAM)
Unter den Eichen 87
12205 Berlin, Germany

✉ info@bam.de
www.bam.de

20250124 BAM KM. Medienteam

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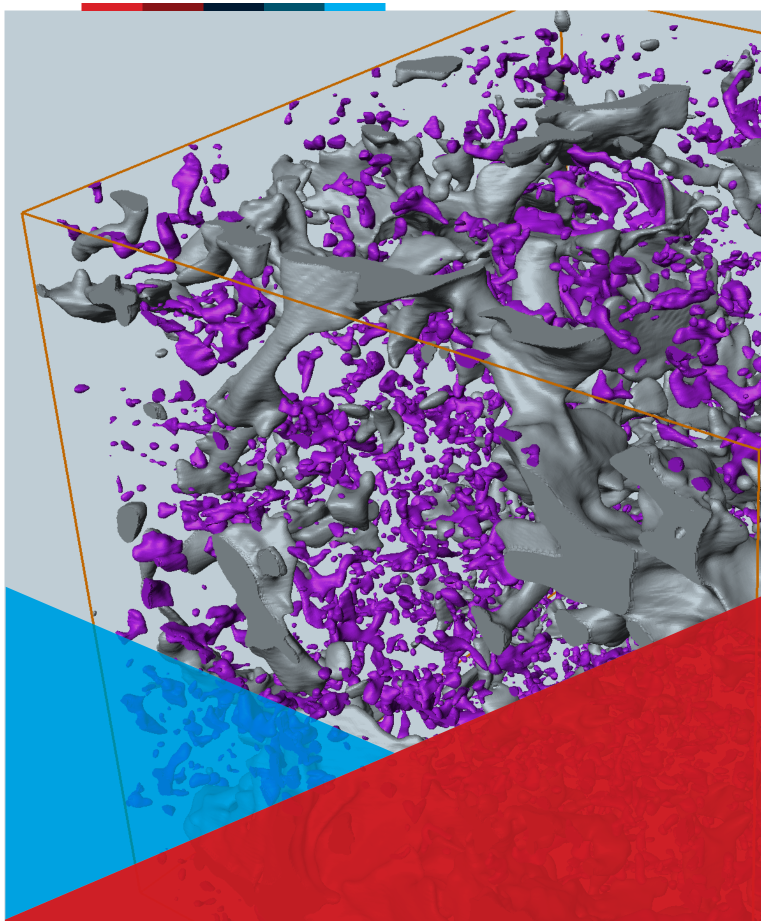
Bundesanstalt für Materialforschung und -prüfung

Sicherheit in Technik und Chemie



MICRO NON-DESTRUCTIVE TESTING

Division 8.5

QUANTITATIVE 3D- MATERIAL CHARACTERIZATION

3D imaging using laboratory and synchrotron X-ray computed tomography (CT)

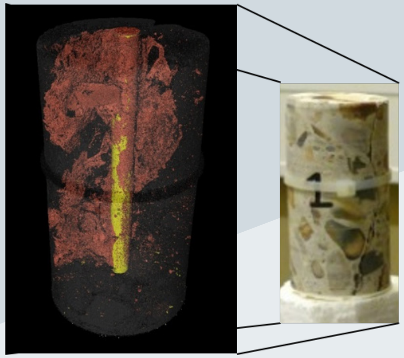
Quantitative analysis of:
- meso- and microstructures
- metrology of internal and external structures
- particle, pore and defect frequencies, size distributions and shapes
- crack density and propagation under mechanical or thermal loads

Development of:
- deformation models
- programs for the simulation of X-ray tomography (aRTist)
- ML for quantitative data analysis
- fast and efficient 3D reconstruction

Typical applications:
- metallic alloys and their composites
- concrete
- composites

Sample sizes:
1-100 mm

Resolution:
1-100 µm



Distribution of corrosion products in concrete (D. Meinel)

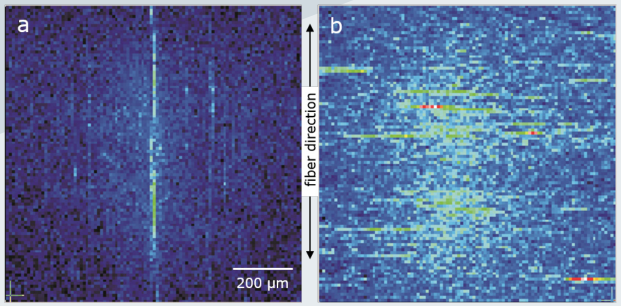
DETECTION OF INTERNAL SURFACES AND DEFECTS

Defects that are too small to be observed with CT can be detected with the in-house developed laboratory and synchrotron X-ray refraction technique, which is based on the refraction of X-rays at internal surfaces such as pores, cracks.

Features with a size down to 1 nm can be detected if they are present in sufficiently large quantities.

Quantitative analysis of:
- spatial distribution of pores, cracks and defects
- damage evolution due to in-situ mechanical stress
- crack, pore and fibre orientation

Typical applications are:
- lightweight composite materials (CFRP)
- micro- and mesostructured materials (e.g. additively manufactured)
- thin metallic components.



Fibre-matrix debonding (a) and density of matrix microcracks perpendicular to the fibre direction (b) in CFRP after impact damage

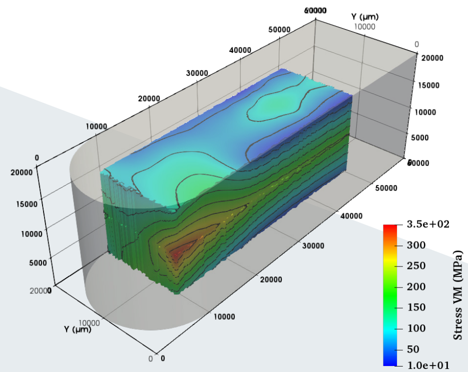
DETERMINATION OF INTERNAL STRESS

3D non-destructive analysis of near surface and bulk internal stresses using high energy X-ray and neutron diffraction techniques.

Analysis of internal/residual stress in a large spectrum of crystalline materials:
- steels, high temperature alloys, light alloys, MMCs and ceramics
- each constituent phase can be detected separately.

Use of in-situ mechanical or thermal loading during diffraction to quantitatively investigate:
- internal stress evolution and load transfer mechanisms in complex materials (e.g. MMCs, AM alloys)
- phase-specific elastic properties of multi-phase materials.

Use of micromechanical models to simulate and rationalize the experimental data.



Bulk residual stress distribution in an additively manufactured IN718 prism (I. Serrano-Muñoz)