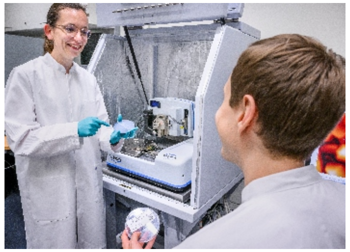
CORE FACILITY II:
SURFACE CHARACTERIZATION

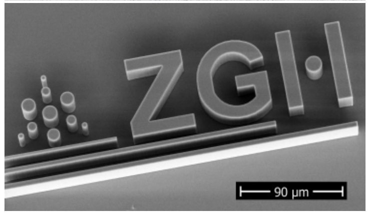
Surface properties often determine how materials interact with their environment, affecting their performance and functionality in various applications. Key methods in CF II: (i) Scanning Probe Microscopy and (ii) Nanoindentation

Dr. Janine Pfetzing-Micklich at the Nanoindenter.



Ellen Suhr and Rico Zehl using the Scanning Probe Microscope.

CORE FACILITY III:
CLEANROOM FOR THE FABRICATION OF MICRO- AND NANOSTRUCTURED SURFACES AND MEMS TOOLS



Logo produced in silicon using deep reactive ion etching (P. Schmitt)

Providing a highly controlled environment combined with advanced equipment for processing and analysis allows the precise fabrication and characerization of micro- and nanostructured surfaces and structures.

Key methods in CF III: (i) Plasma Enhanced Chemical Vapour Deposition (PECVD) , (ii) Reactive Ion Etching (RIE), (iii) Reactive Ion Beam Etching (RIBE), (iv) Advanced Silicon Etching (ASE) and additional methods like Plasma Asher, Spin Coater and Mask Aligner.

CORE FACILITY IV:
COMPUTER CLUSTER FOR INTERFACE SIMULATIONS

Interface simulations play a critical role in understanding and predicting materials behavior at surface and internal interfaces. These simulations can be highly complex and require significant computational resources. In ZGH, a computer cluster consisting of 46 nodes and 240 TB storage is available specifically for interface simulations.

ACCESS TO ZGH

Infrastructure in ZGH can be used by RUB members performing research on materials interfaces. After a brief application, details of ZGH usage are discussed (either service or self-operation of infrastructure is possible), and a user contract is made. Invoicing is performed once a year. Usage from external partners is also possible, please contact us for details.

ZGH TEAM

From left:
Prof. Dr. Alfred Ludwig (Managing Director), Dr. Aleksander Kostka (Scientist), Mathias Redondo Garcia (Student Assistant), Dr. Janine Pfetzing-Micklich (Scientific Manager), Volker Brandt (Technical Support), Dr. Dennis Naujoks (Cleanroom Manager), Jessica Aouag (Technical Support), Dr. Yujiao Li (Scientist).

Contact:
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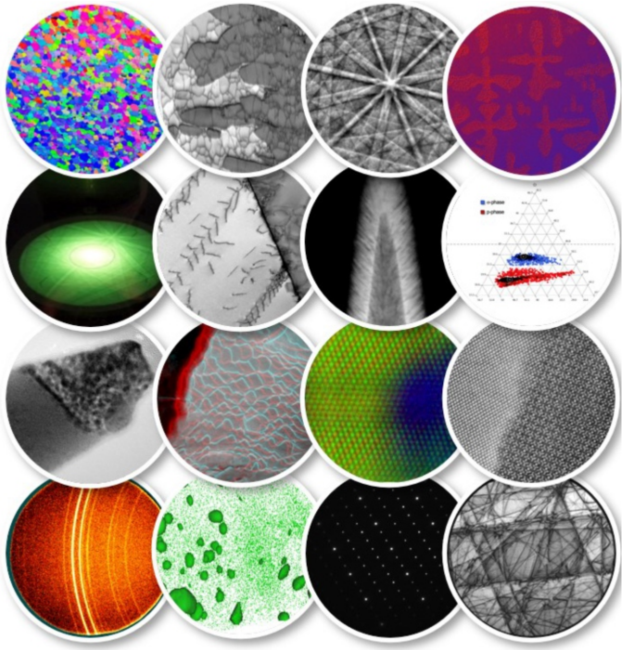
RUHR-UNIVERSITÄT BOCHUM

RUB

ZENTRUM FÜR GRENZFLÄCHENDOMINIERTE HÖCHSTLEISTUNGS-WERKSTOFFE

CENTER FOR INTERFACE-DOMINATED HIGH PERFORMANCE MATERIALS

ZGH



ZGH RESEARCH FOCUS

Interfaces and surfaces play a crucial role in determining the structural and functional characteristics of high-performance materials. At ZGH, research on high-performance materials involves a combination of multi-scale experiments and simulations, spanning from the atomic to the mesoscopic level and up to component dimensions. This research aims to develop a set of broadly applicable principles for interface engineering. These principles are based on a fundamental understanding of interfaces at the atomic level and extend to the complex materials used in technical applications.
Gaining this fundamental understanding requires high-end laboratory equipment and advanced computational resources. The ZGH offers this infrastructure organized into Core Facilities (CF) I to IV.

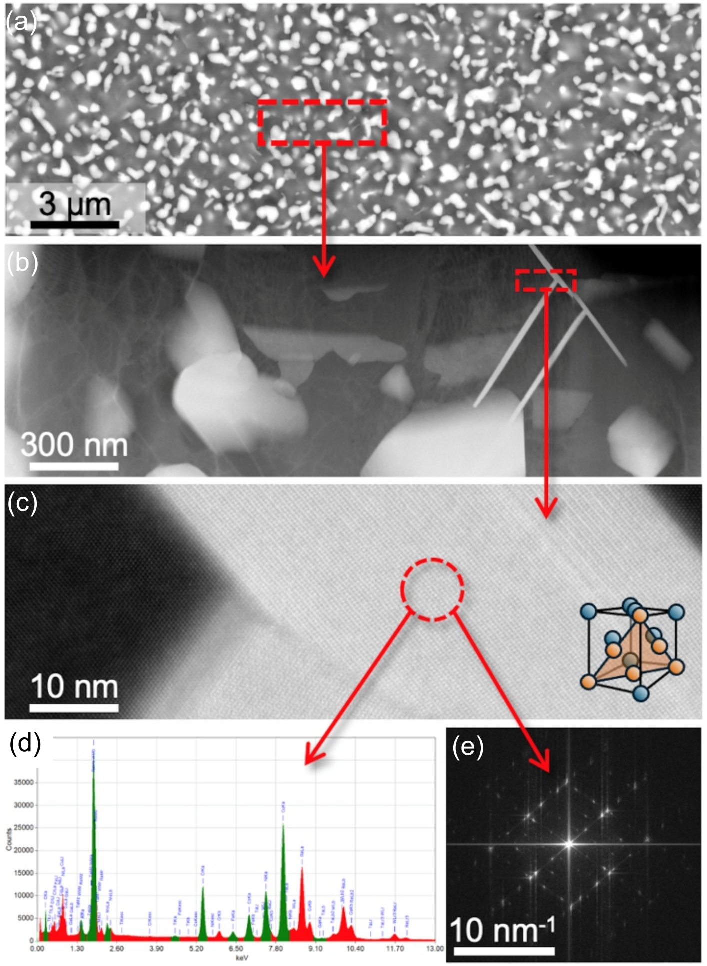
CORE FACILITY I:
ATOMIC SCALE AND TOMOGRAPHIC MATERIALS CHARACTERIZATION

Atomic-scale microscopic characterization is a cutting-edge approach in materials science that provides detailed insights into the structure and properties of materials at the atomic level. These methods involve the use of advanced microscopy and spectroscopy tools to visualize and analyze the arrangement, interactions, and behavior of atoms in a material.
Key methods in CF I are: (i) Transmission Electron Microscopy (TEM), (ii) Atom Probe Tomography (APT) (iii) Focused Ion Beam Technique (FIB), (iv) Scanning Electron Microscopy (SEM), (v) X-Ray Diffractometry (XRD), (vi) X-Ray Tomography (µ CT) and additional equipment like Low Energy Ion Polisher and additionally metallographic sample preparation techniques.

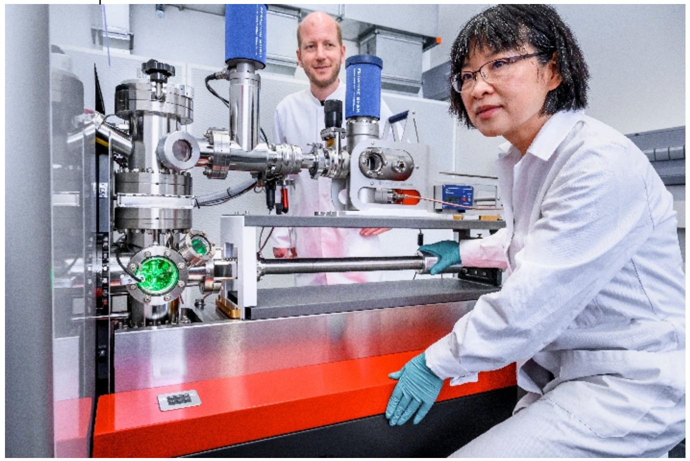
Dr. Aleksander Kostka at the ZGH Abberation corrected Transmission Electron Microscope (TEM).

EXEMPLARIC RESULTS

(i) Materials Characterization using Electron Microscopy

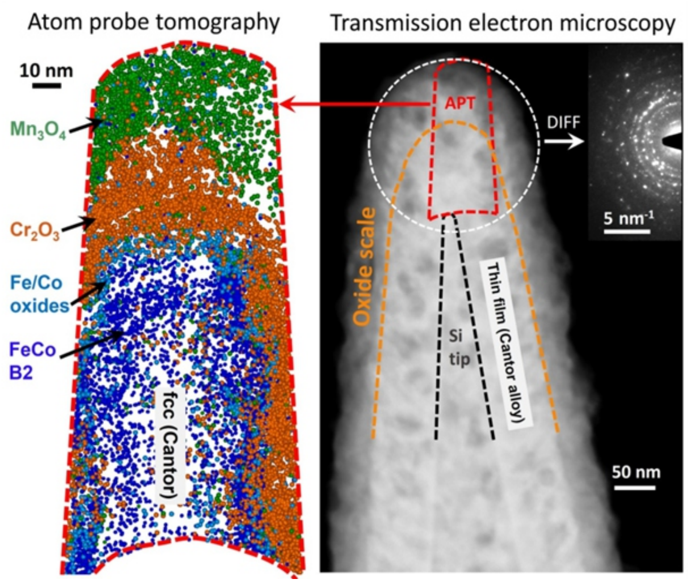


Systematic electron microscopy characterisation of a sputtered and annealed superalloy thin film (a) At the micro scale, the SEM reveals TCP precipitates (white contrast)in the γ‘ matrix. (b) Higher magnification (ADF STEM detector) uncovers a new type of thin, elongated species. (c) At the smallest hierarchy level, the aberration-corrected TEM delivers an image with atom arrangement, the (d) corresponding EDS spectrum, and an (e) electron diffraction pattern. This information is essential to identify the type of these small precipitates and elucidate their origin.



ZGH scientist Dr. Yujiao Li and ZGH technician Volker Brandt working at the Atom Probe Tomography (APT).

(ii) Correlative APT/TEM of a nanocrystalline CoCrFeMnNi alloy



Near-atomic scale characterization of a nanocrystalline CrMnFeNiCo high-entropy alloy (HEA) after five minutes of eyposure in air at 500 °C using correlative TEM/APT analysis. APT reveals individual aoms of multilayered oxide scales on the surface of the HEA thin film, while TEM identifies crystal structures of the oxides. Deep insights into the mechanisms and sequence of oxidation of the HEA are achieved.