METHODS We operate a unique portfolio of facilities and methods for the design, synthesis, characterization and testing of advanced materials and materials systems, with strong emphasis on bridging length scales from atomistic to macroscopic. This includes top-down und bottom-up routes to synthesize nanostructured materials, a multitude of high resolution methods for nanoscale characterization of microstructure and chemical composition, in-situ structural and functional characterization, also in harsh environments, and testing under near in-service conditions.

MONTAN UNIVERSITÄT LEOBEN

DEPARTMENT MATERIALS SCIENCE

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DEPARTMENT MATERIALS SCIENCE

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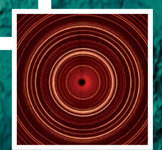

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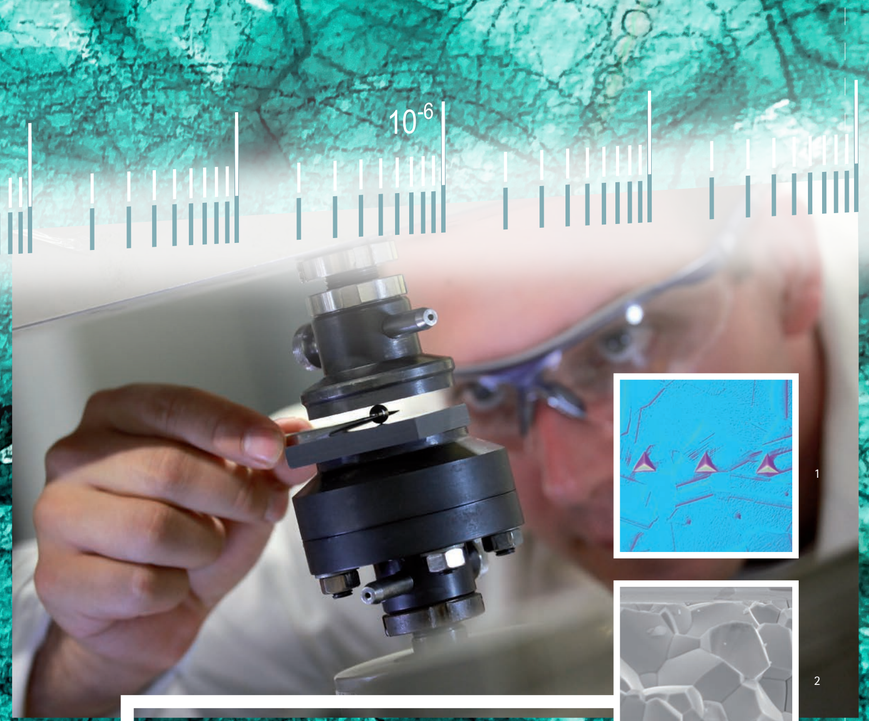
NANO Our comprehensive research covers all material classes, including metals and alloys, intermetallics, ceramics, semiconductors, polymers as well as composite and hybrid structures. The development of novel materials by experimental and quantum-mechanical design approaches strives to elucidate the effect of alloying elements, point defects, dislocations, crystalline and amorphous phases, and interfaces on the stability and properties of materials and on thermally-activated processes such as diffusion and creep.

1. An atomistic model of a cubic rock-salt structure.
2. 3D atom probe tomography reconstruction of a nanolamellar CVD TiAlN coating.
3. TEM image of a perlitic steel for railways with precipitates in the ferrite between the cementite lamellae.
4. In-situ TEM observation of twinning - detwinning plasticity in a Au nanowire
5. Diffraction pattern of a hot rolled γ-TiAl based multiphase material.



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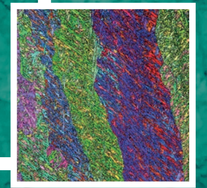

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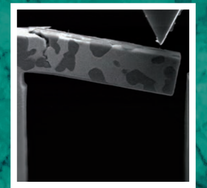

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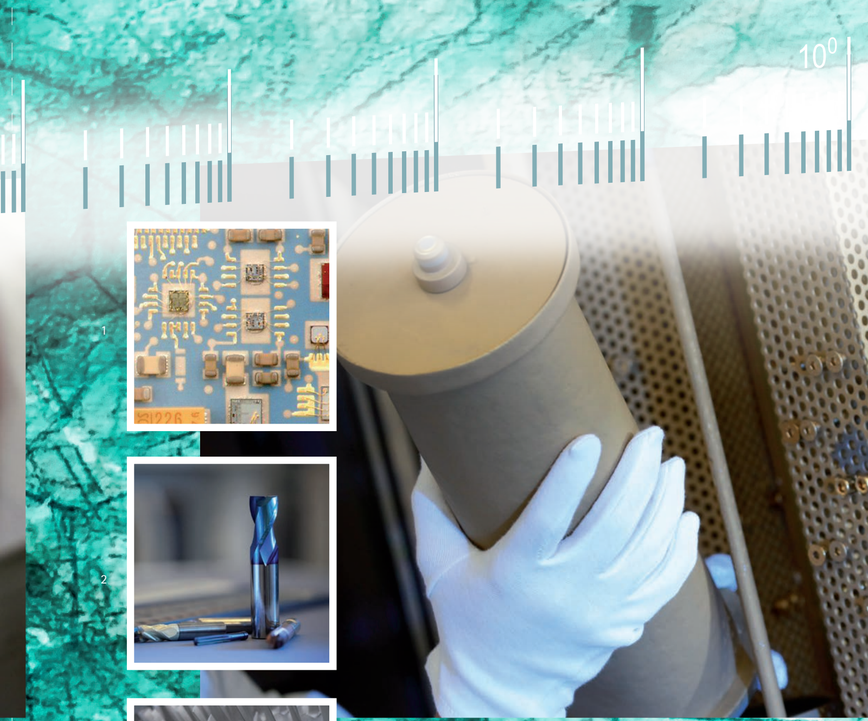
MICRO We establish a detailed and fundamental understanding of the relationship between structures and properties of materials and material systems, supported by a profound knowledge on deformation, phase transformation, non-linear processes, degradation and fracture behavior. Our goal is to lay the foundation for a tailored microstructural and architectural design of novel structural and functional materials with enhanced performance.

1. Light microscopical image of nanoindentation imprints in an annealed equimolar high entropy alloy.
2. SEM micrograph of an intergranular fracture surface of a transparent functional ceramic.
3. EBSD image of the columnar solidification structure in an ultra-high strength steel weld.
4. In-situ SEM microfracture testing of crack propagation in a Cr-Al_2O_3 composite.



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MACRO By applying our scale-bridging fundamental understanding of materials behavior, we explore innovative design protocols for components, devices and systems in communication, energy, health, and transport technologies. Experiments are supported by modeling and performance evaluation under close-to-application conditions, in collaborative research with industrial partners. We contribute to the development of environmentally friendly and energy-efficient materials solutions. Our findings are transferred to society via publications and academic education, aiming to build a solid knowledge basis for future applications.

1. Microelectronic functional components mounted on a ceramic-based printed circuit board.
2. Cutting tools equipped with wear resistant hard coatings.
3. Components from high performance materials for low-emission propulsion systems.