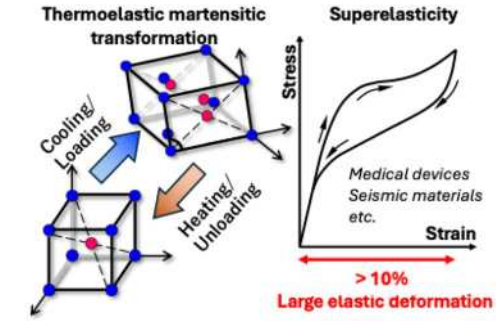
Name	Job Title	Area of Expertise
AKAMINE Hiroshi	Associate Professor	Functional Alloys, Electron Microscopy

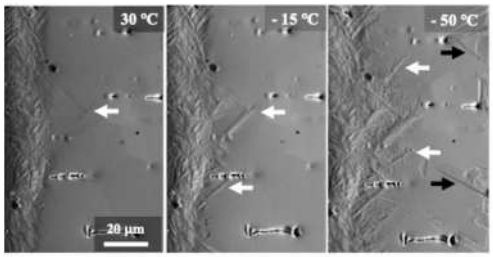
1. Main Research Topics

① Phase Transformation Mechanisms in Next-Generation Shape Memory Alloys

Shape memory alloys (SMAs) exhibit unique functionalities such as the shape memory effect, in which a deformed material recovers its original shape upon heating, and superelasticity, which allows elastic deformation exceeding 10%—far beyond that of conventional metals. These properties originate from a solid-state phase transformation known as the thermoelastic martensitic transformation. While SMAs are already widely used in consumer products and medical devices, further improvements in performance and cost-effectiveness could significantly expand their applications to fields such as civil engineering, architecture, and solid-state refrigeration.

We aim to elucidate the mechanisms of phase transformations through microstructural analyses, thereby developing novel SMAs and/or enhancing shape memory properties. Emphasis is placed on in situ observations under external fields such as thermal cycling and mechanical loading, which allow direct visualization of phase transformation processes.



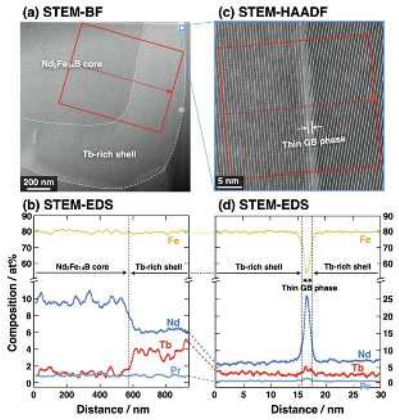


Direct observation of phase transformation upon cooling (Akamine et al. 2023)

② Microstructural Analysis Using Electron Microscopy

Electron microscopy is an important analytical technique for the development of advanced materials and devices based on nanotechnology. Modern electron microscopy enables nanoscale analysis of lattice defects, chemical composition, crystallographic orientation, and electronic states. Through electron microscopy-based characterization, we are actively engaged in collaborative research on the development of a wide range of functional materials.

- Deformation behavior of titanium alloys
- Grain boundary structure of neodymium magnets
- Microstructure of PLD-grown thick-film magnets
- Microstructure of fluoride-based ion battery materials



Microstructure analysis by STEM (Itakura et al. 2024)

2. Keywords

Shape memory alloys, Phase transformation, Electron microscopy

3. Remarks and Websites

We actively welcome collaborative research involving microstructural characterization using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). In addition, evaluations of mechanical properties—such as tensile testing, thermal analysis, and electrical resistivity measurements—provide valuable insights for the development of advanced materials. Please feel free to contact us if you are interested.

We are also aiming to advance research on the practical implementation of shape memory alloys (SMAs) in society. Current interests include SMA-based actuators, solid-state cooling systems driven by thermal cycling, and structural applications in the fields of architecture and civil engineering. We welcome inquiries from those interested in collaboration.

researchmap: https://researchmap.jp/akhr-rmap
Laboratory: https://www.cms.nagasaki-u.ac.jp/lab/kessho/