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Microspectroscopic analysis of iron meteorite using photoelectron emission microscopy (PEEM)

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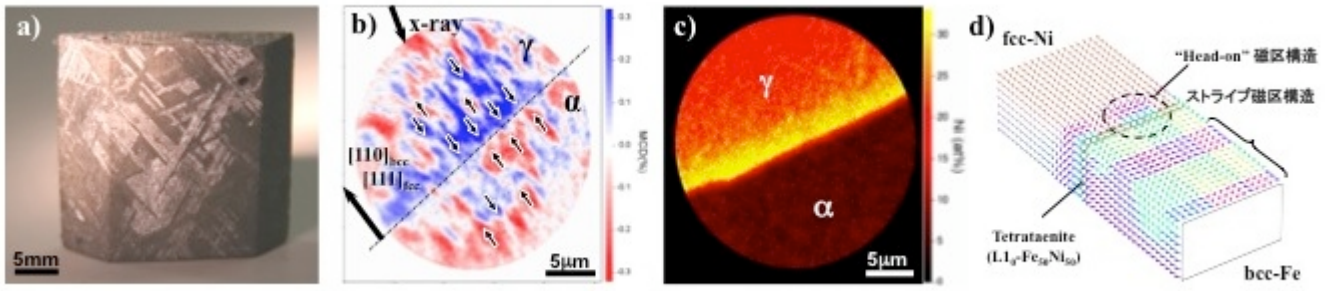
The magnetic properties of iron meteorites greatly differ from those of iron-nickel alloys found on Earth, the reason for which has long been veiled in mystery. The scientists of this research team approached this mystery of the magnetic properties of iron meteorites by accurately evaluating their physical properties from the viewpoint of materials science and, at the same time, considering that such accurate evaluation will be effective for the exploration of other magnetic materials.

They directly observed iron meteorites at the nanometer level using a photoemission electron microscope (PEEM) at SPring-8, and discovered a new magnetic domain structure, which has never been found in conventional iron-nickel alloys. (PEEM is a cutting-edge microscope that came under the spotlight because of its use in the research awarded the 2007 Nobel Prize in Chemistry.) By comparing the magnetic domain structure obtained in the experiments with that obtained by simulation, it was clarified that the magnetic domain structure originates from tetrataenite, an iron-nickel phase unique to iron meteorites.

This tetrataenite phase, originating from the universe, does not contain rare metals and exhibits excellent functionalities; therefore, it is expected to lead to the achievement of high density and power saving as well as resource saving in next-generation magnetic devices. Currently, the artificial creation of tetrataenite and the evaluation of its physical properties are ongoing, aiming towards its application to such devices, which are expected to have a productive ripple effect on future green nanotechnology.



Keywords: iron meteorite, synchrotron radiation, photoelectron emission microscopy, microscopy, magnetic structure, paleomagnetism