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1996 Ph.D., Engineering in Materials Science at University of Tokyo, Japan

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POSTECH GIFT
Graduate Institute of Ferrous & Energy materials Technology

2021

Fall Semester

GIFT

Seminar

Time: Sep. 30th 4:30~5:45pm

Location: ZOOM

Speaker: **Dr. Takahito Ohmura** (NIMS)

Host: Prof. Sung-Joon Kim

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Nano-mechanical characterization in Fe alloys for interpretation of macroscopic deformation behavior

Indentation-induced deformation behavior in constituent phases of austenite, ferrite and cementite in steels are investigated by nanoindentation to understand origins of macroscopic stress-strain behavior. Nanoindentation load-displacement curves for an individual retained-austenite grain with micron size in Fe-C and Fe-Ni steels show an indentation-induced transformation, and the stability of the austenite phase depends on the grain size [1,2]. The stability of the austenite grain is presumably affected by carbon concentration increasing by diffusion from martensite phase and constraint by a surrounding martensite phase with higher hardness. Ferrite-cementite interfaces in pearlitic steel show different plasticity initiation behavior with different coherency [3]. The critical stress for plasticity initiation is lower for a semi-coherent ferrite-cementite interface than that for an incoherent one. Since the steel with a semi-coherent ferrite-cementite interface shows continuous yielding phenomenon in macroscopic stress-strain curve, the lower critical stress for plasticity initiation at the interface could be an origin of the yielding behavior. Fundamental interactions between dislocation and grain boundary in an ultra-fine-grained IF steel were directly captured through TEM in-situ straining technique. Dislocations were absorbed by a grain boundary at the stress level much lower than the macro yield stress, and therefore, the dislocation density decreases with strain [4]. The local behavior presumably leads to the extra-hardening for macro yield stress in the UFG steel, which can be interpreted based on Johnston-Gilman model. A local intermittent plasticity in a single crystal Fe follows a power-law function model, suggesting a scale-free phenomenon like a dislocation avalanche [5]. The fractal dimension is higher in the bcc Fe than that in fcc metals, which can be revealed by separating from a plasticity initiation by a thermally-activated process.