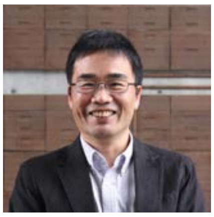

IN SITU TRANSMISSION ELECTRON MICROSCOPY OF DEFECT DYNAMICS IN METALLIC MATERIALS

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Dynamics of lattice defects often governs the degradation processes in metallic materials under various extreme environments. Nuclear-fission and fusion structural materials are degraded primarily due to the accumulation of radiation-produced lattice defects, such as point defects (self-interstitial-atoms (SIAs) and vacancies) and point-defect clusters (prismatic dislocation loops and cavities). During the deformation process of metals and alloys in the presence of hydrogen, large amounts of vacancies and their clusters are formed, and it has been implied that these hydrogen-induced vacancies and vacancy clusters can be a dominant factor for hydrogen embrittlement.

We have been examining defect dynamics in metals, using in situ transmission electron microscopy (TEM) [1, 2]. For these studies, we utilized high-voltage electron microscopes (HVEMs) in Osaka University and Nagoya University in Japan, ion-accelerator combined microscopes in Shimane University in Japan and JANNuS-Orsay facility in France, and recently an atomic-resolution magnetic-field-free microscope [3] installed in Shimane University [4] being powerful for observation of magnetic materials such as iron and steels.

In this talk, I will show that the defect behavior in iron, the primary component of ferritic steels, often looks anomalous and even scientifically interesting, as well as technologically important. The provided topics are: (1) formation of SIA allotropic clusters as precursors for dislocation loops, (2) effects of hydrogen on defect behavior, and (3) anomalous temperature dependence of the interaction between a gliding screw dislocation and a radiation-produced dislocation loop.

References

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