Curriculum Vitae

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Birth data and place: April 3, 1947 and Yamaguchi Prefecture, Japan

Educational background:

- 1970 BC: Kyoto University (School of Engineering), Japan
- 1972 MC: Graduate school of Kyoto University, Japan (Materials Science and Engineering)
- 1978 Doctor of Engineering (submitted the doctor dissertation to Kyoto University)

Professional carrier:

- 1972: Research assistant of Ibaraki University (Department of Mechanical Engineering)
- 1982: Associate professor of Ibaraki University (Department of Metallurgical Engineering)

  (July 1982 - Nov. 1983: Guest researcher of Lawrence Berkeley Laboratory, University of California, U.S.A.)
- 1991: Professor of Ibaraki University (Department of Materials Science)

  (March 1997 - Jan. 1998; Guest researcher: University of Washington, U.S.A.)
- 2004: Professor of Ibaraki University (Graduate school of Science and Engineering; Institute of Applied Beam Science)

  (2010-2011 President of the Iron and Steel Institute of Japan)
- 2010 – present: Guest researcher of Japan Atomic Energy Agency (J-PARC center)
- 2013: Professor Emeritus of Ibaraki University; Special missioned professor of Ibaraki University

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Multi-Scaled Heterogeneities in Microstructures and Deformation Behaviour in Steels

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Microstructural parameters elucidated by TEM, SEM/EBSD and 3D-ATP are important to evaluate as bulk averaged values by neutron and/or synchrotron X-ray diffraction. The volume fraction of metastable austenite determined by various methods show the trend to become larger for TEM, SEM/EBSD, X-ray and neutron, in order. This is because martensite transformation occurs easily near specimen surface. If the measurement were performed at elevated temperatures, only the result by neutron diffraction would agree with that determined by dilatometry. The reason why EBSD and X-ray diffraction provide lower amount is the change in chemical composition near the surface, particularly concentrations of C and Mn. However, the EBSD monitoring for austenite reversion is very useful showing good agreements with the results by *in situ* neutron diffraction as long as the influence of change in chemical compositions can be ignored. As an example of phase transformation monitoring with neutron diffraction, peak intensity, shift and broadening during pearlite transformation will be presented to reveal new insights on transformation mechanism. Now, such a monitoring during advanced thermomechanically controlled processing is possible at J-PARC MLF.

Elasto-plastic deformation occurs heterogeneously in steels caused by anisotropic elastic properties of austenite, ferrite and cementite single crystals and hierarchically multi-scaled heterogeneous microstructures. *In situ* neutron diffraction measurements during tensile deformation have revealed the superposition of various kinds of internal stresses due to multiscaled eigen (misfit) strains. Intergranular stresses and dislocation densities in individual <hkl> oriented grain families are discussed for austenite steel, stress partitioning behaviour between hard and soft packets for martensite steel (packet stresses), that between two constituent phases for a DP steel (phase stresses). In pearlite steel, the intergranular, colony and phase stresses are found to be superimposed related to multi-scaled heterogeneous plastic flow based on its microstructure.

To achieve high strength without losing ductility, many investigations to develop ultra-fine multi-phase microstructure steels have been performed. It is noted that the uniform elongation disappears with decreasing grain size to sub-micron meters because of poor dislocation accumulation ability i.e, low work-hardening. To overcome this drawback, several attempts have been made to increase work-hardening including multi-phase design (phase stress), TRIP, TWIP, *etc*. Interestingly, in most of such cases showing ultra-high yield strength, discontinuous yielding takes place accompanying the Lüders deformation. The transition from continuous to discontinuous yielding behaviour, the magnitude of Lüders strain and new applications of such high strength-ductile steels are open for discussion.