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Title: “Alloying effects on microstructure development in high strength steels – from bulk to surface”

Abstract:

High strength of low alloy steels are accomplished by addition of interstitial elements (i), mainly carbon and in some case nitrogen. However, further improvement in properties as well as good robustness in heat treatment processes are achieved by additions of substitutional alloying elements (s). Substitutional alloying effects on microstructure formed during heat treatments are of a wide variety in terms of thermodynamics, kinetics as well as crystallography depending upon kinds of steels. These are still very fascinating areas in fundamental and applied physical metallurgy research of steels because of a large unexplored field for applying the current advanced characterization techniques.

In this presentation, two aspects in the interplay between carbon/nitrogen and substitutional alloying elements; (1) alloy partitioning during forward ferrite/bainite transformation from supersaturated austenite matrix, and (2) nanoscale i-s clustering in ferrite or austenite during heat treatments.

The first topic corresponds to control of phase stability of retained austenite in multiphase high strength sheet steels. The degree of carbon enrichment into austenite matrix during ferrite transformation is strongly affected by migration kinetics of ferrite/austenite interphase boundary. Substitutional elements affects strongly on the ferrite growth kinetics with its partitioning and segregation, leading to non-equilibrium partitioning of carbon. Such alloy partitioning behaviors are summarized in terms of alloying elements and discussion is extended into lower temperature cases, i.e., on bainite transformation.

The second topic is related to solid solution and precipitation strengthening of alloyed steels. Carbon and nitrogen both have strong tendencies in nano-scale clustering in iron lattice. It has been shown recently that such interstitial elements (i) form co-clusters with substitutional alloying elements (s) having strongly attractive interactions with carbon and nitrogen, leading to nano-precipitation of alloy carbides and nitrides. As typical examples, nanoscale i-s clustering in nitrided steels as well as interphase precipitation of nanoscale alloy carbide in low alloy ferritic steels are explained and discussed.

**Biography:**

Tadashi Furuhashi is a professor at the Institute of Materials Research (IMR) and the at Tohoku University in Sendai, Japan. He joined IMR in 2005 after having served as a faculty member in Kyoto University for 15 years. He was also the former IMR director.

His research achievements concern phase transformations in metallic materials, microstructure control by thermomechanical processing in ferrous and non-ferrous alloys as well as surface heat treatments of steels. In particular, he made a systematic application of advanced electron microscopy and atom probe tomography to reveal the fundamental principles in microstructure-property control of metallic materials. During his academic career, he has published 365 journal papers, 65 proceeding papers, 65 review articles and 17 book chapters.

He also made various services to academic societies, e.g., a president of Iron and Steel Institute of Japan, a vice-president of Japan Institute of Metals, a director of the Japan Society for Heat Treatment, a committee chair/member in TMS. Furthermore, he is currently an editor of *Acta Materialia* and *Scripta Materialia*.