MM 1: Topical Session Interface-Dominated Phenomena - Moving Interfaces

Time: Monday 10:00–11:00 Location: H8

Invited Talk MM 1.1 Mon 10:00 H8

Using mobile interfaces to rapidly move atoms and create sharp chemical boundaries in Fe-C-Mn alloys — •Sybrand van der Zwaag — TU Delft, Delft, the Netherlands

In this presentation we will show how cyclic partial phase transformations in Fe-X alloys and low alloyed steels can be used to rapidly displace substitutional solute atoms and to leave behind ridges of solute atoms upon reversal of the interface migration. These enriched regions locally retard the passing interfaces during a subsequent transformation and this causes a macroscopically detectable halting of the rate of transformation and/or a change in resulting microstructure.

The concept works not only for diffusional and bainitic phase transformations but can (under well-selected conditions) also be used to manipulate the austenite to martensite transformation and to create nano-structured medium Mn steels with exceptional mechanical properties such as a strength above 2 GPa and a uniform elongation in excess of 20%.

The experimental observations are linked to 1D and 3D transformation models and in-situ TEM observations of the moving interface.

MM 1.2 Mon 10:30 H8

Abnormal grain growth in nanocrystalline PdAu: The Case of the Fractal Fingerprint — Raphael A. Zeller[1], Christian Braun[2], Markus Fischer[1], Jörg Schmauch[2], Christian Kübel[3], Rainer Birringer[2], and •Carl E. Krill III[1] — [1]Institute of Functional Nanosystems, Ulm University, Ulm, Germany — [2]Department of Experimental Physics, Saarland University, Saarbrücken, Germany — [3]Karlsruhe Nano Micro Facility, Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

In most polycrystalline materials, coarsening tends to be a civilized affair, with adjacent grains taking pains to exchange atoms so as to maintain a smooth boundary. The grains that grow in nanocrystalline PdAu, however, behave like uncouth neighbors crashing a fancy dinner party: once they get revved up, all hell breaks loose! Before you know it, a few nanometer-sized grains have grown four orders of magnitude in diameter, and the resulting interfaces are so convoluted that they resemble fractal objects. Our usual notion of curvature-driven grain boundary migration fails to explain the persistence of these interfacial fluctuations, but recent experiments find the onset of fractality to depend on the Au concentration as well as on a characteristic length scale. We consider this evidence to be a kind of “fractal fingerprint” that, ultimately, incriminates a specific mechanism as being responsible for the system’s abnormal grain growth.

MM 1.3 Mon 10:45 H8

Dislocation path and long-range strain associated with interface migration — •Jin-yu Zhang, Zhi-peng Sun, Fu-zhi Dai, and Wen-zheng Zhang — School of Materials Science and Engineering, Tsinghua University, Beijing

Major interphase interfaces generated from phase transformations in steels or Ti alloys are semicoherent. The knowledge of dislocation motion and long-range strain accompanying the interface migration is fundamental to the understanding of phase transformations. In this study, we performed a molecular dynamics simulation on the migration of various α/β interfaces in pure Ti. The simulation results explicitly demonstrated that the interfacial dislocation path can deviate significantly from the slip planes of individual dislocations due to the dislocation interaction when the interface contains multiple sets of dislocations. For these complex situations, previous theories based on conventional slip planes would lead to either non-atom-conservation or slip-sequence-dependent results. We developed a new geometric model, which is capable to generate self-consistent descriptions on the dislocation path and the shear displacement during migration of a general semicoherent interface, in the condition that atoms are conserved during interface migration. This model is validated by the simulations and it covers the simple cases applicable by previous theories. The present study offers new insight into the dislocation path during interface migration and provides a general framework for evaluating the long-range strain caused by interface migration during a phase transformation process, such as precipitation and martensite transformation.