



2018 MSE DOW Lecture

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Tuesday, April 24, 2018

4:00pm Tech L361

Stability of gradient nano-grained structures in metals

Dramatic property variations and unprecedented performances have been discovered in nanostructured metals in which high density interfaces are introduced. However, stability of nanostructures under thermal or mechanical stimuli becomes critical for not only property advancements but processing development as well. For instance, coarsening of nano-sized grains occurs at much lowered temperatures than their coarsen-grained counterparts, as low as ambient temperature in some metals. Grain coarsening may take place even at cryogenic temperatures during plastic deformation. This talk is to present a recent study on grain size dependences of stability in nano-grained metals. Gradient nano-grained samples, in which the spatial variations of grain size are graded from the nano-scale to the macro-scale, were prepared by means of surface plastic deformation. Stability of the nano-grained structures in pure metals and alloys was investigated by annealing at elevated temperatures and under repeated dry-sliding, respectively. Experimental results showed that very small nano-grains below a critical size exhibit extraordinary stability, under both mechanical loading and thermal annealing, in contradictory to the “smaller less stable” trend. The inherent stability of nano-grains may originate from an autonomous grain boundary relaxation to low energy states during plastic deformation of the very fine grains.

Dr. K. Lu received BS in MSE from Nanjing University of Science & Technology in 1985 and PhD in MSE from Institute of Metal Research of Chinese Academy of Sciences (CAS) in 1990. He is a professor and the founding director of Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS. His research interests are nanostructured metals and alloys. He authored and co-authored 390 international journal publications and held 30 patents. He is an elected member of Chinese Academy of Sciences, German National Academy of Sciences Leopoldina, National Academy of Engineering (USA), and The Academy of Sciences for Developing World. He is a Fellow of the AAAS, MRS, and TMS.