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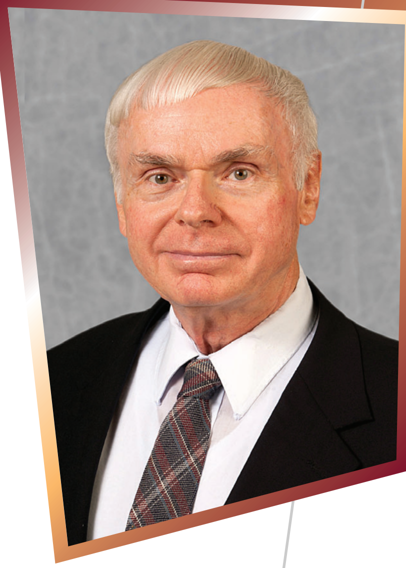

Stabilization of Nanocrystalline Grain Size at Elevated Temperatures: Theory and Experiment

Professor Carl C. Koch

Member, National Academy of Engineering
Kobe Steel Distinguished Professor
Materials Science and Engineering Department, North Carolina State University, USA

Date : 17 May 2019 (Friday)
Time : 4:30pm – 6:00pm (*Light refreshments will be served from 4:00pm to 4:30pm*)
Venue : Senate Room, 19/F, Lau Ming Wai Academic Building
City University of Hong Kong

Abstract

Knowledge of the thermal stability of nanocrystalline materials is important for both technological and scientific reasons. From a technological point of view, the thermal stability is important for consolidation of nanocrystalline particulates without coarsening the microstructure. Understanding the scientific nature of stability, grain growth of nanocrystalline microstructures is a criterion for allowing strategies for minimizing grain growth to be developed.

There are two basic ways in which grain growth can be reduced. The first is the *kinetic approach* in which the grain boundaries are pinned in various ways to decrease grain boundary mobility. The second is the *thermodynamic approach* in which the driving force for grain growth is lowered by solute segregation.

In the kinetic approach the grain boundary mobility is reduced by various possible mechanisms. These include porosity drag, second phase, Zener, drag, solute drag, chemical ordering, and grain size stabilization. The thermodynamic approach depends on introducing solutes that segregate to the grain boundaries such that the free energy of the system reaches a local minimum with respect to grain growth.

This talk will review the theories that have been presented for kinetic stabilization and thermodynamic stabilization. The experimental evidence for grain growth in nanocrystalline materials with solute or second phase additions will then be presented and conclusions regarding the efficacy of the stabilization strategies will be discussed.

Biography

Dr. Koch received his Ph.D. in metallurgy from the Case Inst. of Technology (now Case Western Reserve University) in 1964. He joined Oak Ridge National Laboratory as a staff scientist in 1965. He was the group leader of the superconducting materials and then the alloying behavior and design group before he joined North Carolina State University, Department of Materials Science and Engineering, as a professor in 1983. He is Kobe Steel Distinguished Professor of materials science and engineering. He has made significant contributions to understanding of mechanical alloying for preparation of amorphous and nanostructured alloys. It is in this context that processing has become an important part of his research. He has published over 360 papers and edited or co-edited 7 books. In October 1995 Dr. Koch was cited in Science Watch for the third highest number of citations per paper in the world for high-impact articles in materials science for 1990 through 1994. He has achieved the rank of Fellow in professional societies, including the Minerals, Metals, and Materials Society (TMS), (the membership is limited to 100 living Fellows), the Materials Research Society (MRS), the American Physical Society (APS), ASM International, and the American Association for the Advancement of Science (AAAS). He was elected into the U.S. National Academy of Engineering in 2013.

All are welcome

Enquiries:
Tel: 3442 6611
Email: hkias@cityu.edu.hk

Online registration: www.cityu.edu.hk/hkias/event