

Morris E. Fine

Morris E. Fine, Walter P. Murphy and Technological Institute Professor Emeritus of Materials Science and Engineering, is a pioneer in teaching the unifying concepts underlying all classes of materials: metals, ceramics, polymers, biomaterials, and elec-



tronic materials. He is a founder of Northwestern's materials science and engineering department, the first of its kind in the world. His research career at Northwestern has spanned a broad range of topics, from physical chemistry to mechanical behavior, and includes studies on metals and alloys, ceramics, and composite materials.

Fine received his PhD in physical metallurgy from the University of Minnesota in 1943. After working on the Manhattan Project in Chicago and Los Alamos, he worked for Bell Labs until 1954, when he came to Northwestern.

A member of the National Academy of Engineering and the American Academy of Arts and Sciences, Fine is a fellow of the Minerals, Metals, and Materials Society, ASM International, the American Ceramic Society, and the American Physical Society. He is an honorary member of the American Institute of Mining, Metallurgical, and Petroleum Engineers and the Japan Institute of Metals.

Fine continues to publish and has more than 300 papers to his credit. He has received numerous awards, most recently the TMS 2009 Application to Practice Award for research that led to a new steel with better corrosion resistance, toughness, and welding properties. More than 500 tons of this steel were used for a bridge in Lake Villa, Illinois, that opened in 2006.



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Fourth annual

Morris E. Fine Lecture

Sponsored by the Department of
Materials Science and Engineering

“Watching Microstructure Evolve
in Three Dimensions”

Presented by

Peter W. Voorhees

Frank C. Engelhart Professor of Materials Science and Engineering
Northwestern University

Tuesday, January 8, 2013

Lecture 4 p.m.

Technological Institute, Room L211

2145 Sheridan Road, Evanston

Reception to follow in the atrium, William A. and Gayle Cook Hall

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

“Watching Microstructure Evolve in Three Dimensions”

With the advent of high-energy x-ray sources, it is now possible to follow microstructural evolution in three dimensions and as a function of time. The ability to observe and quantify the evolution of a microstructure provides fundamentally new insights into this complex process, especially for microstructures with complicated interfacial morphologies, such as the two-phase mixtures produced following dendritic solidification.

The evolution of dendritic solid-liquid mixtures is determined using in situ three-dimensional (4D) x-ray tomography. These experiments make it possible to identify the mechanisms responsible for the evolution of the structure and, since the locations of the interfaces are known, to quantitatively explore the relationships between the dynamics of interfacial evolution and interfacial morphology.

In this two-phase mixture, as well as others such as polymer blends, a region of one phase can fission into two by interfacial energy-driven diffusion. We have investigated the evolution of solid-liquid interfaces near these topological singularities by examining the pinching of a rod of one phase embedded in another. We show theoretically and verify through 4D experiments that the interfacial morphology becomes *universal* sufficiently close to the pinching event: the interface shape is independent of the initial morphology of the rod-like phase and material system, and a power law describes its temporal evolution. This universality allows the dynamics of capillary-driven microstructural breakup processes to be predicted in a vast array of materials, from steels to noncrystalline materials such as polymer blends.

Peter W. Voorhees

Peter W. Voorhees is the Frank C. Engelhart Professor of Materials Science and Engineering and a professor in the Department of Engineering Sciences and Applied Mathematics at Northwestern and codirector of the Northwestern-Argonne Institute for Science and Engineering. He is a computational materials expert whose research employs theory, simulation, and experiment in areas ranging from nano-technology and energy to four-dimensional microscopy.



Voorhees's numerous awards include the National Science Foundation's Presidential Young Investigator Award; ASM International's Silver Medal in the Materials Science Division and J. Willard Gibbs Phase Equilibria Award; the Minerals, Metals, and Materials Society's Bruce Chalmers Award; the McCormick School's Award for Teaching Excellence; and listing as a "highly cited researcher" by the Institute for Scientific Information. He is a fellow of ASM International, the Minerals, Metals, and Materials Society, and the American Physical Society. He has

published more than 190 papers in the area of the thermodynamics and kinetics of phase transformations.

Voorhees received a PhD in materials engineering from Rensselaer Polytechnic Institute. He was a member of the Metallurgy Division at the National Institute for Standards and Technology before joining Northwestern's Department of Materials Science and Engineering in 1988.