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The Morphology and Topology of Bicontinuous Phases

Abstract: Bicontinuous two-phase mixtures are found in systems ranging from block copolymers to phase separated alloys and nanoporous metals. Bicontinuous polymer blends are used in organic photovoltaics, and nanoporous metals have a broad range of applications such as catalyst supports and artificial bone. While all these disparate systems yield bicontinuous structures, it is not clear if their morphology and topology (connectivity) are similar. Thus, it is difficult to link their processing and structure, or understand the effects of morphology and topology on the properties of these systems. A suite of tools will be presented that we use to quantify the morphology and topology of these systems, such as the two-point spatial correlations of interfacial curvatures. Using these techniques, the bicontinuous structures found from large-scale simulations of coarsening following spinodal decomposition have been quantified. The morphology, topology, and two-point correlations of nanoporous gold has also been determined. Using the experimental results in nanoporous gold and the simulations of coarsening, we investigate the factors that control the morphology and topology of bicontinuous nanoporous metals.

Biography

Peter Voorhees is the Frank C. Engelhart Professor of Materials Science and Engineering at Northwestern University, and Professor of Engineering Sciences and Applied Mathematics. He is co-director of the Northwestern-Argonne Institute of Science and Engineering and is co-director of the Center for Hierarchical Materials Design. He received his Ph.D. in Materials Engineering from Rensselaer Polytechnic Institute. He was a member of the Metallurgy Division at the National Institute for Standards and Technology until joining the Department of Materials Science and Engineering at Northwestern University in 1988. He has received numerous awards including the National Science Foundation Presidential Young Investigator Award, ASM International Materials Science Division Research Award (Silver Medal), the TMS Bruce Chalmers Award, the ASM J. Willard Gibbs Phase Equilibria Award, the McCormick School of Engineering and Applied Science Award for Teaching Excellence, and is listed as a Highly Cited Researcher by the Institute for Scientific Information. Professor Voorhees is a fellow of ASM International, the Minerals, Metals and Materials Society, and the American Physical Society. He is a member of the American Academy of Arts and Sciences. He has published over 280 papers in the area of the thermodynamics and kinetics of phase transformations.