

# IAS Distinguished Lecture

## Stable Nanocrystalline Metals: Next-Generation Structural Materials from Science to Commercialization

### Professor Christopher A. Schuh

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Massachusetts Institute of Technology

**Date** : 15 May 2017 (Monday)

**Time** : 4:30pm – 6:00pm (*Light refreshments will be served from 4:00pm to 4:30pm*)

**Venue** : Connie Fan Multi-media Conference Room, 4/F, Cheng Yick-chi Building,  
City University of Hong Kong



### Abstract

When the grain size of a metal is refined to a scale on the order of just a few nanometers, its strength, hardness, wear resistance, and other properties improve in dramatic ways. There is therefore significant interest in designing and deploying such nanocrystalline alloys for structural applications. However, refining the grain structure is a struggle against equilibrium, and nanocrystalline materials are often quite unstable; the grains grow given time even at room temperature, and the associated property benefits decline over time in service. In this talk, our efforts to design stable nanocrystalline alloys will be described. We rely on selective alloying as a method to lower the energy of grain boundaries, which can bring a nanocrystalline structure closer to equilibrium. This talk will highlight the path from theory, to proof-of-concept laboratory demonstration, to scale-up and commercialization of such alloys. Beginning from early successes with nanocrystalline alloy coatings, the talk will also outline future opportunities in bulk net-shape products and additive manufacturing. The prospects of stable nanocrystalline metals in a wide variety of applications will be described, including as substitute materials to reduce cost and cost volatility, as greener alternatives to legacy technologies, as next-generation structural materials with large performance increments over incumbent metals, and as an enabler of new 3D printing technologies.

### Biography

Christopher A. Schuh is the Department Head and the Danae and Vasilis Salapatas Professor of Metallurgy in the Department of Materials Science and Engineering at MIT.

Schuh's academic training in Materials Science and Engineering focused on metals, including their processing, microstructure, and mechanics. He earned his B.S. degree from the University of Illinois at Urbana-Champaign in 1997, and his Ph.D. from Northwestern University in 2001. He held the Ernest O. Lawrence postdoctoral fellowship at Lawrence Livermore National Laboratory 2001-2002 before moving to join the faculty at MIT in 2002.

Professor Schuh's research is focused on structural metallurgy, and seeks to control disorder in metallic microstructures for the purpose of optimizing mechanical properties; much of his work is on the design and control of grain boundary structure and chemistry. Professor Schuh has published more than 220 papers and dozens of patents, and received a variety of awards acknowledging his research accomplishments. Professor Schuh has co-founded a number of metallurgical companies. His first MIT spin-out company, Xtalic Corporation, commercialized a process from Schuh's MIT laboratory to control the internal structure in metal electroplated coatings down to the nanometer scale, producing exceptional mechanical and functional properties. These nanocrystalline coatings have been deployed in applications ranging from machine components, to automotive parts, to electronics, and are now in wide and growing usage around the globe. Professor Schuh's startup Desktop Metal is a metal additive manufacturing company developing 3D metal printers that are sufficiently simpler and lower-cost than current options to enable broad use across many industries. Recently, Schuh co-founded Veloxint Corporation, which is commercializing machine components made from custom nanocrystalline alloys designed in his MIT laboratory, with exceptional properties designed to address the most extreme mechanical situations.

In 2011 Professor Schuh was appointed Head of the Department of Materials Science and Engineering at MIT. He also currently serves as the Coordinating Editor of the Acta Materialia family of journals, including Acta Materialia, Scripta Materialia, and Acta Biomaterialia. Among his various awards and honors include his appointment as a MacVicar Fellow of MIT, acknowledging his contributions to engineering education, and his election as Fellow of The Minerals, Metals, and Materials Society.



**All are welcome**

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