UNIVERSITY OF CALIFORNIA
UC RIVERSIDE | Materials Science and Engineering

Wednesday's 1-1:50pm ZOOM

Dr. Andrea Hodge

WINTER 22 COLLOQUIUM SPEAKER

January 5, 2022

Expanding the Fabrication Space of 3D Nano- and Micro-Architected Lattice Materials

A prevalent focus of materials research is the development of ultra-lightweight, multifunctional materials that exhibit unparalleled mechanical properties. Within the last decade, technological advances in additive manufacturing (AM) have enabled the fabrication of novel three-dimensional nano- and micro-architected lattice materials, allowing researchers to investigate previously unexplored phenomena and property spaces. Current printing techniques are mainly restricted to polymer-based systems, which narrow the functionalities and mechanical robustness of these architected lattice materials. While a handful of nano-architected ceramic and metallic systems have been realized by way of pyrolysis, namely SiOC, nanoporous Ni, and glassy carbon, new printable material systems are limited by the chemistry of the resin blend and require further research. Thus, alternative approaches such as the deposition of metallic and ceramic coatings on polymer-based lattice scaffolds offers a flexible and feasible route for expanding the mechanical and functionality space of these advanced materials.

Several novel nano- and micro-lattice materials have been developed through means of various light-based AM methods and coating deposition approaches, namely atomic layer deposition and plating techniques. However, such methods are limited to materials that undergo specific chemical reactions. Thus, magnetron sputtering, a technique that allows for the deposition of a nearly unlimited selection of metals, alloys, and ceramics can be utilized to further expand the synthesis space of these materials. Nonetheless, sputtering is a momentum driven line-of-sight process, and thus achieving uniform coatings on fine featured lattice materials remains a prominent challenge. As such, our work is based on inverted cylindrical magnetron sputtering, a novel coating approach that allows for an unprecedented 360° line-of-sight. In this study, we present a comprehensive comparison between planar and hollow cathode sputtering focusing on the influence of target geometry on plasma characteristics, deposition conditions, and film microstructure on coating uniformity on complex 3-D topologies.

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Andrea Hodge holds the Arthur B. Freeman Professorship of Chemical Engineering and Materials Science and of Aerospace and Mechanical Engineering. She received her Ph.D. degree in Materials Science from Northwestern University. Prof. Hodge served as the Vice Provost for undergraduate programs at USC from July 2016 to June 2020. She is currently Co-Director for Core Center of Excellence in Nano Imaging (CNI) and Chair of the Chemical Engineering and Materials Science Department. She joined USC as an Assistant Professor in 2007 and has co-authored over 90 peer-reviewed publications and two book chapters. Her research focus is the synthesis and microstructural control of nanoscale metals and ceramics for extreme environments. Dr. Hodge is the recipient several prestigious research, mentoring and teaching awards such as, the Minerals Metals and Materials Society (TMS) Julia and Johannes Weertman Educator Award (2020) which speak to her broad educational impact and commitment to serving students.

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