Department of Mechanical Engineering

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Micro-3d-Printing With Polymers, Metals, Nanocomposites And More: The Science And Applications Of Direct-Ink-Writing

In the last decade, additive manufacturing, commonly known as 3D-printing, has enabled numerous new technologies outside the conventional design and manufacturing paradigms including artificial tissues and organs, multi-functional soft robots and wearable devices, and flexible-hybrid electronics. One of the key manufacturing requirements to unlock such technologies is the capability to synergistically integrate different materials in a single product. Among the available AM methods, extrusion-based methods, particularly direct-ink-writing (DIW) emerged as the primary approach to address this need due to its broad material capabilities, ease of use and low cost. In DIW, the material “inks” are continuously extruded out of micro-scale nozzles and deposited along digitally defined paths. Despite its exciting potential, DIW lacks the resolution and precise control over material properties that are required for the broader implementation of the aforementioned technologies. This talk will present the ongoing research in the Manufacturing Processes and Machinery Lab at Washington State University towards addressing the shortcomings of DIW by miniaturizing the process. This research aims to understand the complex rheological and thermofluidic behavior of inks derived from various material systems at micro-scales and develop methods to control this behavior towards achieving high resolution structures with “as-designed” properties.

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Dr. Arda Gozen is the George and Joan Berry Associate Professor at the School of Mechanical and Materials Engineering of Washington State University. He obtained his Ph.D. degree in mechanical engineering in 2012 from Carnegie Mellon University where he also worked as a post-doctoral research associate. Prior to his Ph.D. studies, Dr. Gozen obtained his B.S. degree from Middle East Technical University, Ankara, Turkey. He is the recipient of 2019 NSF CAREER and WSU Voiland College of Engineering and Architecture Junior Faculty Research awards. He is the author of over 30 journal publications, numerous conference proceedings and holds 2 patents. His research interests include micro- and nano-scale manufacturing, soft-materials and rheology, flexible-stretchable devices, mechatronics and instrumentation, dynamic systems and controls and, precision engineering.