

Mechanical Engineering Seminar Series

March 18, 2026, 11:00AM

EIS 104

Title: From Powder to Performance: Advancing Binder Jet Metals

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Abstract: Binder jet printing (BJP) is gaining momentum as a scalable metal additive manufacturing platform because it decouples shaping from densification, enabling low residual stress, isotropic microstructures, and high production throughput. Yet major challenges remain: achieving full density without distortion, fabricating complex internal architectures, and expanding the process to oxidation-sensitive alloys such as aluminum. In this seminar, I will present a research trajectory that began at Michigan State University and continues at Naval Research Laboratory, aimed at overcoming these barriers through integrated process science and accelerated materials screening. In collaboration with Prof. Patrick Kwon, foundational work on stainless steel 316L established sintering protocols capable of producing near-full-density parts without infiltration, revealing key process–structure–property relationships in BJP. Building on this framework, we demonstrated the fabrication of various SS-based microfluidic or microchemical devices including micro-preconcentrators, micro-reactors, and micro-heat exchangers. For the second part of the seminar, I will present our recent efforts to dramatically reduce development costs for new alloy systems in BJP. We have introduced a soft-molding approach that replicates green-body chemistry and thermal processing while eliminating the need for layer-by-layer printing during screening. This rapid methodology was first verified with SS316L, showing the effect of the boron nitride sintering additive and binder burnout. Then we performed systematic exploration of binder chemistries, additive strategies, and sintering atmospheres for Al6061, achieving density and mechanical performance greater than what has been reported in the literature. Collectively, this work illustrates a scalable pathway for accelerating alloy qualification, expanding the materials portfolio of BJP, and enabling structurally robust, geometrically complex metal components for aerospace and defense applications.

Bio: Dr. Junghoon Yeom is currently a research engineer at US Naval Research Laboratory (NRL), where he conducts fundamental and applied research in solid mechanics, soft active materials, energetic materials, and multi-physics systems. He also leads and supports multi-disciplinary R&D programs focused on structural and failure analysis, transportability and advanced materials systems for military applications. Yeom obtained his MS (2003) and PhD (2007) in Mechanical Engineering from the University of Illinois, Urbana-Champaign and his BS (2000) from Yonsei University, Seoul, Korea. Prior to joining NRL, he was an assistant professor in the Department of Mechanical Engineering at Michigan State University. He also worked at a start-up company, named Cbana Labs Inc., in an effort to commercialize a MEMS-based gas chromatography system and led the NASA lunar surface analysis project as a principal investigator. His research interests include MEMS/NEMS, nanomaterials, chemical sensing, microfluidics, and additive manufacturing. He holds six patents and has co-authored one graduate-level textbook, *Nanofluidics and Microfluidics: Systems and Applications*, two book chapters, 80+ peer-viewed journal papers and conference proceeding papers.