"Accelerated Nanomaterial Discovery and Manufacturing with Self-Driving Fluidic Labs"

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Bio: Milad Abolhasani is an ALCOA Professor, a University Faculty Scholar, and the Director of the Graduate Program in the Department of Chemical and Biomolecular Engineering at North Carolina State University. He also serves as the Director of Accelerated Technologies within NC State's Integrative Sciences Initiative. Dr. Abolhasani received his Ph.D. from the University of Toronto in 2014. Prior to joining NC State University in 2016, he was an NSERC Postdoctoral Fellow in the Department of Chemical Engineering at MIT. At NC State University, Dr. Abolhasani leads a cross-disciplinary research group that studies self-driving labs tailored toward accelerated discovery, development, and manufacturing of advanced functional materials and molecules using fluidic micro-processors. Dr. Abolhasani has received numerous awards and fellowships, including *NSF CAREER Award*, *AIChE 35 Under 35*, *Dreyfus Award for Machine Learning in the Chemical Sciences & Engineering*, *Scialog Fellowship*, *AIChE CRE Early Career Investigator Award, AIChE NSEF Young Investigator Award, I &EC Research 2021 Class of Influential Researchers*, *AIChE Futures Scholar*, *ALCOA Research Achievement Award*, *ACS-PRF Doctoral New Investigator Award*, and Emerging Investigator recognition from *Nanoscale, Lab on a Chip*, *Reaction Chemistry & Engineering*, *Digital Discovery*, and *Journal of Flow Chemistry*.

Abstract: The current human-dependent nature of experimental research in chemical and materials sciences fails to identify technological solutions for renewable energy, sustainability, and healthcare challenges in a short timeframe. This limitation necessitates the development and implementation of new strategies to accelerate the pace of discovery. Recent advances in reaction miniaturization, robotics, automated experimentation, and artificial intelligence (AI) provide an exciting opportunity to reshape the discovery and manufacturing of new materials through *human-AI-machine* collaboration. In this talk, I will present the recent work in my lab on the development of *Self-Driving Fluidic Labs* (SDFLs) as intelligent robotic co-pilots to human researchers to accelerate discovery, development, and manufacturing of advanced functional materials by 100×-1000× compared to the *status quo*. I will discuss how modularization of different nanomaterial synthesis and processing stages in tandem with a constantly evolving machine learning modeling and decision-making under uncertainty can enable a resource-efficient navigation through high dimensional experimental design spaces (>10^{20} possible experimental conditions). Example applications of SDFLs for the autonomous synthesis of colloidal quantum dots will be presented to illustrate the potential of autonomous robotic experimentation in reducing nanomaterial synthetic route discovery timeframe from >10 years to a few months. Finally, I will present the unique reconfigurability aspect of SDFLs to close the scale gap in nanomaterials research through facile switching from the reaction exploration/exploitation to smart nanomanufacturing mode.