BRINGING A NANOMATERIAL DEPOSITION TECHNOLOGY TO MARKET

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Abstract: Many next-generation functional coatings or films will incorporate nanomaterials. At the laboratory scale, nanomaterial-based coatings have shown the potential to improve performance and enable new functionality in applications like thermal barrier coatings on high-temperature parts, active layers in electronic devices, anti-reflective coatings on glass, and biocompatible coatings for medical applications. In all cases, these coatings should be able to be formed over large areas at commercial production rates and yields, with uniform and controllable thickness, and their constituent particles should retain their nanoscale-properties.

In this talk, I will introduce aerosol impact-driven assembly (AIDA), a gas-phase method to deposit nanomaterials as a coating, and discuss the insights and challenges encountered in transitioning this technology from a university laboratory to industrial (pilot) production through a start-up company. AIDA accelerates an aerosolized nanomaterial—which may be generated from pre-existing feedstock or synthesized in situ in the AIDA machine—through a slit-shaped nozzle into a chamber held under rough vacuum. The nanomaterial is accelerated to a velocity of several hundred meters per second by the resulting pressure drop. A substrate in the deposition chamber is passed through the “curtain” of accelerated particles, and the nanomaterial collides with and adheres to the substrate, forming a coating.

I will demonstrate the use of AIDA in forming coatings ranging from sub-monolayers of silver particles on water filtration membranes for biofilm mitigation to many-micron-thick porous silica coatings for transparent insulation. I will also show AIDA hardware and processes scaled to produce multi-layer coatings on substrates up to one meter wide at substrate translation speeds of greater than 10 meters per minute.

Bio: Zachary Holman is an Associate Professor in the School of Electrical, Computer, and Energy Engineering at Arizona State University, as well as the Director of Faculty Entrepreneurship. He received his Ph.D. in Mechanical Engineering from the University of Minnesota for his work on plasma-synthesized silicon and germanium nanocrystals, after which he spent two years as a postdoctoral researcher developing high-efficiency silicon solar cells at Ecole Polytechnique

Fédérale de Lausanne in Switzerland. His research group at ASU focuses on new semiconductor materials, processes, and device designs. He has been named a Moore Inventor Fellow, Trustees of ASU Professor, Fulton Entrepreneurial Professor, and Joseph C. Palais Distinguished Faculty Scholar, and he is the co-founder of three start-up companies based on ASU research: Swift Coat, Sunflex Solar, and Beyond Silicon.