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Scaling-up Nanoparticle Beam Deposition for Green Synthesis of Advanced Materials †

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Abstract: The deposition of size-controlled nanoparticles (atomic clusters) onto supports from the beam is a solvent-free, green route to small-scale manufacturing of functional nanomaterials. To translate the beautiful physics and chemistry of clusters into practical applications, e.g., coatings, catalysts, biochips, biomaterials, and photonic materials, significant scale-up of the rate of deposition is needed [1,2], while reducing the loss of material in the process (to say 1-10%). For example, the deposition rate needed for industrial catalyst R&D is 10mg/hour of clusters, while for bespoke pharmaceutical manufacturing, 1-10g/hour is required. In this talk, I will discuss both the fundamental aspects of deposited clusters at the atomic-scale – as revealed by aberration-corrected scanning transmission electron microscopy [3,4] – and the status of efforts to meet the scale-up challenge, with emphasis on our "Matrix Assembly Cluster Source" (MACS) [5]. Some first practical demonstrations [6-10] of deposited clusters in heterogeneous and electrocatalysis will be presented, showing attractive activities and selectivities [1, 6-10], as an illustration of what might be done in fields as diverse as surface engineering, theranostics, photonics, and neuromorphic.

Keywords: nanoparticle; scaling-up; matrix assembly cluster source.

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Conflicts of Interest

The authors declare no conflict of interest.