Abstract Submitted for the DFD20 Meeting of The American Physical Society

A physics-Based Statistical Model for Nanoparticle Deposition¹ BCHARA SIDNAWI, DONG ZHOU, BO LI, QIANHONG WU, Villanova University, QIANHONG WU TEAM — Nano particle deposition is widely observed in biological systems, medical procedures, and manufacturing processes, etc. However, while instructive, the theoretical studies found in the literature only describe the phenomena on a case-by-case basis without a unifying framework. Physically, whether a nanoparticle will deposit on a substrate solely depends on the substrate-particlesolution interfacial energies and the particle's incident velocity vector upon impact. Since the number of particles is usually too big to consider every single one of them, much of this phenomenon is stochastic in nature. In this paper, a physics-based mathematical model is proposed to analyze nanoparticle deposition on a substrate. Based on statistical and physical considerations, the model quantitatively predicts the substrate's coverage evolution and growth rate. Its validity was verified by a dip coating experiment where a Polydimethylsiloxane (PDMS) substrate was periodically immersed in a sonicated graphene nanosheets solution. This study is expected to spur future endeavors in systematically characterizing film coating, drug delivery and other processes involving particle depositions.

¹This work is supported by the National Science Foundation's grant: NSF CMMI 2003077

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Date submitted: 28 Jul 2020

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