Causes and Consequences of Powder Bed Charging in Electron-Beam Additive Manufacturing

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***Abstract*—Electron-beam additive manufacturing (EBAM) is a recently developed metal 3D printing process that uses a high-power electron-beam (e-beam) to fuse powder feedstock layer-by-layer into a bulk net-shaped object. This process has several key advantages over other metal 3D printing processes, including fast build rates and the ability to maintain the powder bed at an elevated temperature; however, a major drawback of EBAM is its low yield, especially when developing recipes for new feedstock materials. A common challenge that leads to build failures is excessive powder bed charging. The e-beam injects electrons into the powder feedstock and under certain conditions, this charge can accumulate on the powder feedstock. In extreme cases the resulting electrostatic forces can become so great that they drive the particles from the build envelope in a process known commonly as "smoking". This talk will present a physics-based model of this powder bed charging phenomena and describe strategies for mitigating excessive charging and for improving the yield of EBAM.**