
Numerical Simulation of Fine Particle Deposition by Impact

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Abstract

Fine particle deposition by impact is attracting great interest for forming thin films for the next generation of dielectric charge storage devices. This technique has great potential for fabricating composite thin films of ceramic-ceramic, ceramic-metal, ceramic-polymer, etc. It offers advantages such as low process temperature, high-speed deposition rate and fine patterning, hence making it a very suitable coating technique for heat and oxidation sensitive materials. The resulting film thickness, quality and particle deposition ratio are strongly dependent on the film formation process. Work reported in the literature is largely limited to the evaluation of the thin film performance with little attention to mechanics of the particle deposition process. We report our work on investigating the effect of particle size, physical and mechanical properties and deposition conditions on the formation of thin film on a solid surface using a coupled simulation of computational fluid dynamics (CFD) and Discrete Element Method (DEM). The particle adhesion is modelled by a linear model of elasto-plastic and adhesive contact deformation developed at the University of Leeds. The aerodynamics of the particle jet flow near the substrate surface is analysed. The results reveal that the particle impact velocity is reduced by the reflection of the jet flow and by the resistance of the air layer near the substrate under atmospheric conditions.

Keywords: Fine Powder Deposition, Plastic, Elastic Adhesion Model, Deposition Conditions

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