

Dynamics of charged particulate systems: modeling, theory and computation

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Abstrak

The objective of this monograph is to provide a concise introduction to the dynamics of systems comprised of charged small-scale particles. Flowing, small-scale, particles ("particulates") are ubiquitous in industrial processes and in the natural sciences. Applications include electrostatic copiers, inkjet printers, powder coating machines, etc., and a variety of manufacturing processes. Due to their small-scale size, external electromagnetic fields can be utilized to manipulate and control charged particulates in industrial processes in order to achieve results that are not possible by purely mechanical means alone. A unique feature of small-scale particulate flows is that they exhibit a strong sensitivity to interparticle near-field forces, leading to nonstandard particulate dynamics, agglomeration and cluster formation, which can strongly affect manufactured product quality. This monograph also provides an introduction to the mathematically-related topic of the dynamics of swarms of interacting objects, which has gained the attention of a number of scientific communities. In summary, the following topics are discussed in detail: (1) Dynamics of an individual charged particle, (2) Dynamics of rigid clusters of charged particles, (3) Dynamics of flowing charged particles, (4) Dynamics of charged particle impact with electrified surfaces and (5) An introduction to the mechanistic modeling of swarms.