Numerical Analysis of Particulate Flows during Stirred Media Milling of Barium Titanate Nanoparticles

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Three-dimensional multiphase flow simulations are performed to model stirred media milling of barium titanate nanoparticles, a base material for electronic components such as multilayer ceramic capacitors. Velocity and volume fraction of each of the solvent, beads, and barium titanate phases in a laboratory-scale mill are solved using the mixture model, in addition to residence time distributions obtained from mass transfer calculations. Simulation results demonstrate a well-mixed system without dead zones or parallel paths, facilitated by intense secondary flows driven by centrifugal forces at high rotation rates. However, simulations also suggest shortcomings of the system such as bead segregation due to the same centrifugal forces and large variance in residence time distributions, which need to be addressed in future designs of stirred media mills for milling of barium titanate nanoparticles.