October 23rd, 2020

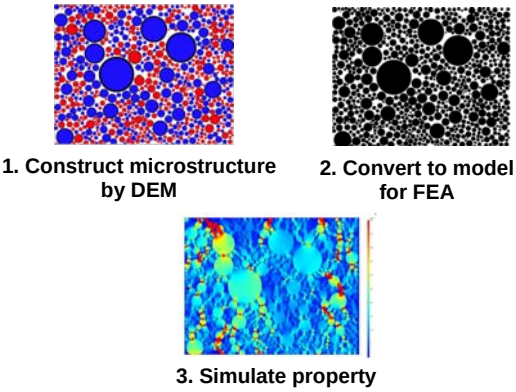
Computer-aided Formulation of Magnetic Pastes for Additive Manufacturing of Power Magnetics

Chao Ding[1,2], Khai D.T. Ngo[2,3], and Guo-Quan Lu[1,2,3]

[1]Dept. of MSE, Virginia Tech;
[2]Center for Power Electronics Systems (CPES), Virginia Tech; and
[3]The Bradley Dept. of ECE, Virginia Tech

Abstract

To simplify the fabrication and integration of magnetic components in power electronics converters, magnetic pastes have been explored as the feedstock for additive manufacturing of magnetic components. However, most of magnetic pastes reported in the literature suffer from low relative permeability (μ_r) or low saturation magnetic flux density (B_{sat}) due to the low magnetic packing density. The traditional method for developing magnetic pastes involves experimental iterations with trial-and-error efforts to figure out the optimal compositions. To shorten development cycle and take advantages of computational power in current age, this project focuses on exploring a computer-aided way to correlate material's processing, microstructure, and property to guide material formulation. Discrete element method (DEM) modeling was explored to generate materials' microstructure and finite element analysis (FEA) modeling was utilized to study the properties. With the guidance provided by computer simulations, a series of magnetic pastes with adjustable properties was developed and used as feedstock for additive manufacturing of novel magnetic components.



The flow of computer-aided formulation method for magnetic paste development

Biography

Chao Ding received the B.S. degree in Materials Science and Engineering from Tianjin University, Tianjin, China, in 2016. He is currently working toward the Ph.D. degree in Materials Science and Engineering in Dr. Guo-Quan Lu's group and he is expected to graduate in 2021. He is working on soft magnetic composites for power magnetics and high-temperature power module packaging. Chao has authored 6 journal papers and 5 conference papers.