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Dynamic modeling of bulk superconductors with different E-J relationships for high temperature superconducting Maglev systems

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Three ***E-J*** relationships describing the electromagnetic behavior of the high-temperature superconducting (HTS) bulk over a permanent magnet guideway (PMG) are discussed in this paper. They are the power law model (PLM), the flux flow and creep model (FFCM), and the flux flow model (FFM). With the aid of the finite element software COMSOL Multiphysics, these models were successfully established combining with the AC/DC module and the Heat Transfer module. The irregularity of the surface of the real PMG is considered in the modeling by applying a small-amplitude vertical vibration function to the guideway which is built as a geometric entity. In view of the application of high-speed HTS magnetic levitation (Maglev) system, compared with the experimental data, the dynamic response of the levitation force, the temperature distribution and the current density distribution of the HTS bulk under different vibration frequencies was analyzed. This work can provide a reference for the modeling of the dynamic response of the electromagnetic-thermo-force characteristics of the HTS Maglev system.

Keywords: high temperature superconducting bulk, power law model, flux flow model, flux flow and creep model