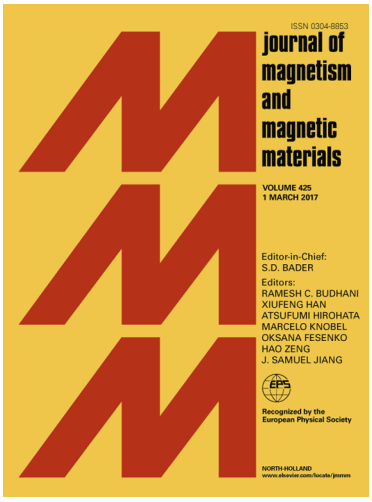

Simulation of magnetic particles in microfluidic channels

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Simulation of magnetic particles in microfluidic channels

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Abstract

In the field of biomedicine the applications of magnetic beads have increased immensely in the last decade. Drug delivery, magnetic resonance imaging, bioseparation or hyperthermia are only a small excerpt of their usage. Starting from microscaled particles the research is focusing more and more on nanoscaled particles. We are investigating and validating a method for simulating magnetic beads in a microfluidic flow which will help to manipulate beads in a controlled and reproducible manner. We are using the soft-matter simulation package ESPResSo to simulate magnetic particle dynamics in a lattice Boltzmann flow and applied external magnetic fields. Laminar as well as turbulent flow conditions in microfluidic systems can be analyzed while particles tend to agglomerate due to magnetic interactions. The proposed simulation methods are validated with experiments from literature.

Keywords: CFD, magnetic particle dynamics, hydrodynamics, lattice Boltzmann method, excluded volume force, mass point

1. Introduction

Magnetic beads are used and investigated in many fields of biomedical research in the last decades [1]. Drugs can be delivered to regions of interest. Contrast agents for magnetic resonance imaging (MRI) are helping health professionals to more easily locate disturbance sources. Bioseparation of DNA, blood cells, various macro-molecules, antigens etc. is now possible. The destruction of tumor tissue with high-frequency magnetic fields has been demonstrated.

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