Modelling of spin-polarized transport in semiconductors

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Abstract

Spintronics is a young science trying to subjugate spin of electron and make it work for the civilisation as well (and even better) as electron's charge works now in microelectronic devices. Some scientists speculate that semiconductor spin-based devices (e.g. spin field-effect transistor, spin diodes) can be more efficient than their counterparts based only on charge current.
We consider the matrix drift-diffusion model which except for charge densities and charge current considers three spin components and their currents. The model is derived from matrix Boltzmann equation. It consists of four continuity equations for charge and spin densities and Poisson equation for electric potential. The system is fully coupled and nonlinear.
We present some analytical results for continuous system as well as for its finite volume discretization: we proved existence of a unique bounded weak solution to the system and of a bounded numerical solution. The proves are based on different reformulations of the model. Furthermore free energy functions for continuous and discrete cases are presented and some results of numerical experiments for finite volume scheme are shown.

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