Departamento de Matemática Aplicada

Instituto de Matemática Interdisciplinar

SEMINARIO DE MATEMÁTICA APLICADA

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Deterministic and Stochastic PDEs Applied to the Simulation of Nanotechnological Devices

Nanotechnology is a young field and, at the same time, a natural source of deterministic and stochastic multiscale problems. Nanotechnological devices often have a fine structure, yet we are interested in their functioning at much larger length scales. Furthermore, noise and fluctuations play an important role in such small devices and usually limit their performance. This motivates the use of stochastic PDEs.

We present a collection of results from the modeling and simulation of nanowire bio- and gas sensors, of nanopores, and of composite materials. Homogenizations results for sensor surfaces and elliptic equations are presented. Numerical results for the stochastic Poisson-Boltzmann equation for this application are shown as well. The stochastic drift-diffusion-Poisson system allows to model charge transport: we present an existence and local-uniqueness result as well as a multi-level Monte-Carlo algorithm. Existence and local uniqueness for the deterministic drift-diffusion-Poisson system modeling a sensor in the alternating-current regime was proved as well. Furthermore, an optimal approach to the numerical stochastic homogenization of elliptic problems is discussed; the application are composite materials. Finally, we discuss a stochastic problem stemming from the simulation of nanopore sensors.

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