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3D simulations of F-N-electron emission in Scanning Probe Lithography (SPL)

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The scanning probe lithography (SPL) is based on the F-N-field-electron emission from a SPM- nanotip and an exposure of a calixarene resist. Since the emitted electron energies are in the range of a few ten electron volts, i.e., in the range of the binding energies of the resist molecules, they are chemically triggered and converted into volatile compounds. The field emission is enhanced due to the geometry of the nanotip (lightning rod effect). Until now, the mechanisms and conditions behind the physical processes are not clearly understood. Therefore, we simulate the emission process using a 2D and 3D model. The 2D method consists of the computation of the emission probability at the tip excluding the original electron energy and of the electron trajectories using a Velocity-Verlet algorithm. Our 3D model additionally includes the electron energy distribution inside the tip and the 3D geometry of an axial symmetric tip. Thus, we are able to calculate a realistic electron energy distribution at the surface with our 3D model. We will compare the two models with experimental Fowler-Nordheim data to show the dependence of the electron density and the energy distribution of the electrons. Additionally, we will present the electric field and electron distribution influenced by the resist material.

Biography

Steve Lenk, Dipl.-Ing. is project coordinator assistant of the European FP7 project, "Single Nanometer Manufacturing beyond CMOS devices" (SNM). He graduated from the Faculty of Technical Physics at Technische Universität Ilmenau, specializing in Theoretical Physics and Semiconductor Physics, in 2009. In his Diploma thesis, he calculated the excitonic dielectric function of GaN. He works currently at his PhD with the topic simulations of the Fowler-Nordheim emission of electrons from ultra sharp nanotips for lithography. He has experience in scientific programming, analytical solutions, and EU projects management. He has 3 publications in scientific journals.

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