HL 31: Silicon-based Semiconductors I

Time: Tuesday 12:15–13:00 Location: H14

HL 31.1 Tue 12:15 H14

Ultrahigh Sensitivity Chemical and Biological Sensors Based on Silicon Junctionless Nanowire Transistors — •Yordan M. Georgiev[1], Ran Yu[2], Elizabeth Buitrago[3], Adrian M. Nightingale[4], Olan Lotty[2], Nikolay Petkov[2], and Justin D. Holmes[2] — [1]Institute of Ion Beam Physics & Materials Research, HZDR, Dresden, Germany — [2]Materials Chemistry and Analysis Group, Department of Chemistry and Tyndall National Institute, UCC, Cork, Ireland — [3]Nanoelectronic Devices Laboratory, EPFL, Lausanne, Switzerland — [4]Nanostructured Materials & Devices Group, Department of Chemistry, Imperial College London, UK

Junctionless nanowire transistors (JNTs) are very promising as chemo-biosensors due to their simple structure, easy fabrication and potential for ultrahigh sensitivity. Therefore, JNT sensors with various numbers, lengths, and widths (down to 10 nm) of the nanowires were fabricated by a top-down process on positively doped SOI wafers. The nanowires were functionalised either with 3-aminopropyltriethoxysilane (APTES) or with APTES and biotin. Polydimethylsiloxane (PDMS) stamps with microfluidic channels were then attached to the chip surface and buffer solutions containing different analytes were flowed over the sensors by a syringe pump. In this way, series of experiments for sensing ionic strength, pH value, and the protein streptavidin were performed. The JNT sensors demonstrated the highest sensitivity reported to date towards streptavidin, corresponding to a detection of only few protein molecules.

HL 31.2 Tue 12:30 H14

A microscopic theory of valley dependent *g*-factors in Si/SiGe quantum dots — •Marko Rancic and Guido Burkard — University of Konstanz, 78464 Konstanz, Germany

In this theoretical study we model a Si/SiGe quantum dot with a micromagnet embedded on top. The micromagnet is present in order to achieve two-axis control of the electron spin states by oscillating it in real space (EDSR). The two-axis control of the electron spin is a necessary prerequisite for implementing a spin-based quantum bit. When both valley-orbit mixing and an in-plane magnetic field gradient are present the electronic g-factor can become valley dependent. The tilted Si/SiGe interface causes the valley and orbit degrees of freedom to mix, while the in-plane magnetic field gradient comes from the micromagnet. The formalism treats step-like interface defects as a continuous tilt of the Si/SiGe quantum well. Our findings suggest that the valley g-factor becomes valley dependent for a large parameter regime of the electrostatic confinement potential. Furthermore, by knowing the measured difference of valley dependent g-factors we are able to predict the valley splitting in a Si/SiGe quantum dot.

HL 31.3 Tue 12:45 H14

Lattice location of Se in hyperdoped Si — •Fang Liu[1,2], Slawomir Prucnal[1], Kun Gao[1,2], René Heller[1], Lars Rebohle[1], Wolfgang Skorupa[1], Manfred Helm[1,2], and Shengqiang Zhou[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany

Se implanted Si wafers with very high doping concentrations exceeding the solid solubility limit have been formed by ion implantation and subsequently by flash lamp annealing. Rutherford backscattering spectrometry/channeling and Raman scattering have been used to determine the recrystallization and lattice location of Se in implanted Si layers after flash lamp annealing. It is found that the crystal order of the implanted sample can be recovered with a high quality after optimal annealing [1]. In order to study the incorporation site of Se, angular maps across planes {100} and {110} were carried out. Prominent channeling effects are observed, which is strong evidence that most of Se atoms are located on substitutional lattice sites. The detailed angular scans along [001] and [110] reveal a small displacement of Se impurities from the substitutional lattice sites.

[1] S. Zhou, F. Liu, S. Prucnal, K. Gao, M. Khalid, W. Skorupa and M. Helm, Scientific Report 5, 8329 (2015).