

Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf



MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, June 24, 2019, at 11:00 a.m.;

— all are invited to meet at around 10:40 for a chat with coffee & cookies —

Dr. Neil Curson

London Centre for Nanotechnology,
Faculty of Mathematical & Physical Sciences,
University College London.

Using scanning probes to fabricate and characterise nanoscale donor devices in silicon

PC Seminar Room G2.06, Building G, Faradayweg 4

A. Kölker

Abstract:

Atomic and nano-scale structures consisting of dopants buried in silicon can be used to make novel quantum devices. The process of fabricating buried donor structures using scanning tunneling microscope-based lithography, combined with precursor gas adsorption and molecular beam epitaxy will be described. In addition, the electrical and optical characterisation of such structures will be discussed.

The first characterisation technique is scanning microwave microscopy (SMM), which we demonstrate to be a non-invasive probe of the *quantitative* 3D spatial location and sheet conductivity of three-dimensional dopant nanostructures, buried hundreds of atomic layers below a silicon surface. Secondly we electrically characterise the terahertz response of a dilute 2D layer of phosphorus dopants, buried 15 nm below the surface of silicon. Our measurements reveal new physics about the interaction of donor Rydberg states with their local environment. Finally we expand the current device fabrication toolbox by demonstrating that phosphorus and arsenic co-doped nanostructured devices can be made, and discuss the potential opportunities that such devices offer.