NEUER FORSCHUNGSBEREICH

Two-dimensional materials - a new playing ground for engineers

Graphene is a two-dimensional (2D) crystal made up of carbon atoms arranged in a honeycomb lattice. It is only one atomic layer thick, which makes it the thinnest material known to exist. Graphene also happens to be the strongest material, an excellent conductor for both electric current and heat, highly transparent and very flexible and stretchable. Since its first experimental demonstration in 2004, researchers have suggested quite a number of potential applications for graphene, and microelectronics and sensors are amongst the most promising candidates.

More recently, a growing number of other 2D crystals has been (re-)discovered, among them transition metal dichalcogenides (TMDs). These TMDs consist of a metal backbone, covered on both sides by sulfur, selenium or tellurium. Some of these materials have semiconducting properties like the TMD molybdenum disulfide (MoS2), others are insulating like hexagonal boron nitride, and some are semimetals like graphene. Beyond utilizing these materials in applications, it seems possible to conceive completely novel materials with application specific properties in the future, simply by stacking different 2D crystals one atomic layer at a time.

The Group of Graphene-based Nanotechnology at the University of Siegen investigates electronic, optoelectronic and nanoelectromechanic devices made from graphene and related 2D materials. A strong focus is on the experimental demonstration and proof-of-concepts of novel device ideas. The research is carried out in our clean room laboratory and includes 2D transistors for analog applications, 2D-material based photodetectors and piezoresistive sensors from 2D membranes.

Even though integrated devices are at the core of the research, aspects of process technology and process integration complement the activities. In addition to the proof-of-concept of novel devices, we collaborate with industry like Infineon or pmd technologies as well as the circuit design community to address questions of manufacturability and system compatibility of the new 2D materials and devices.

Fig. 1:
Ball-and-stick model of graphene.

Fig.2
Schematic of a MoS_2 field effect transistor.

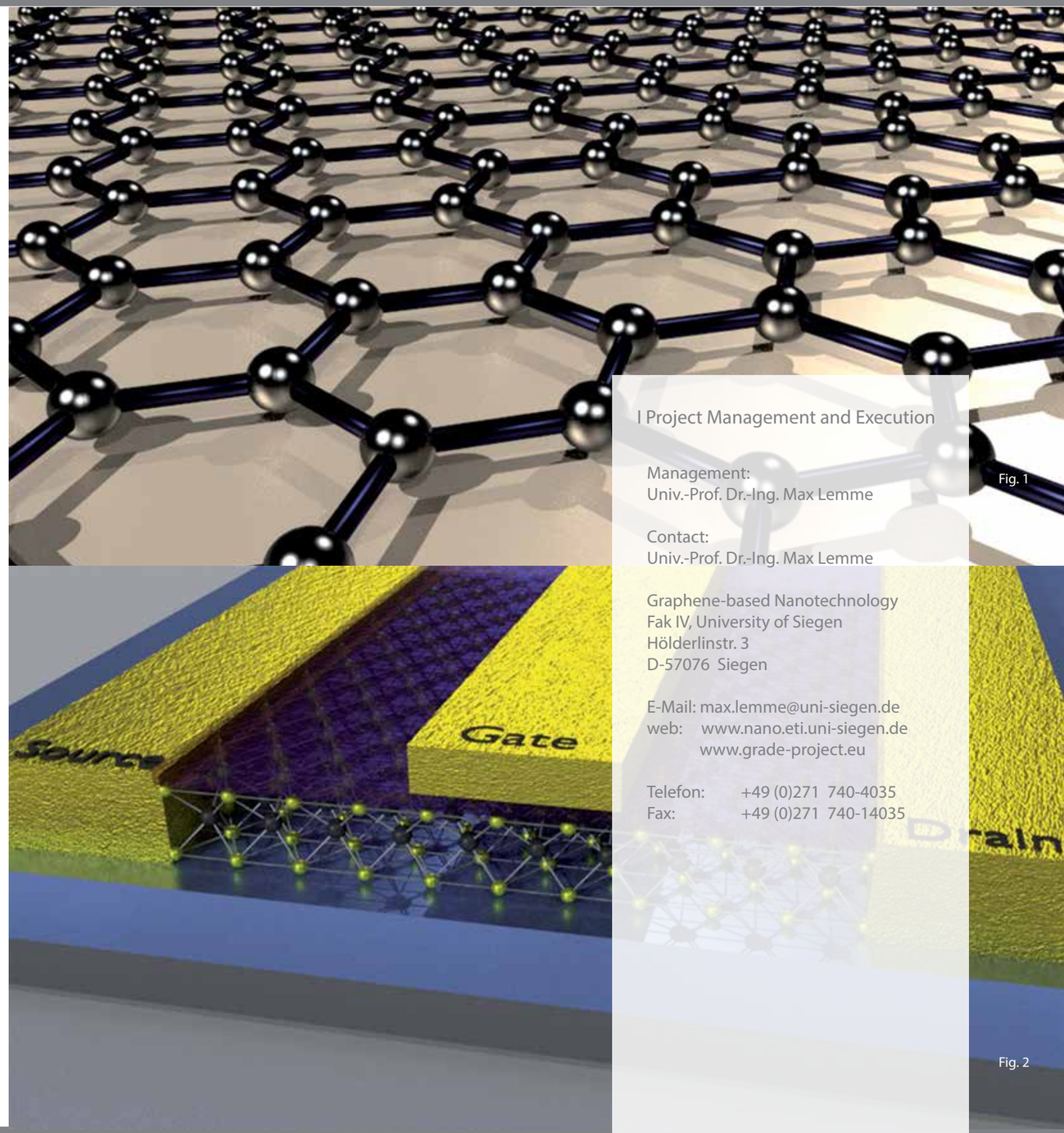

Fig. 1

Fig. 2

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