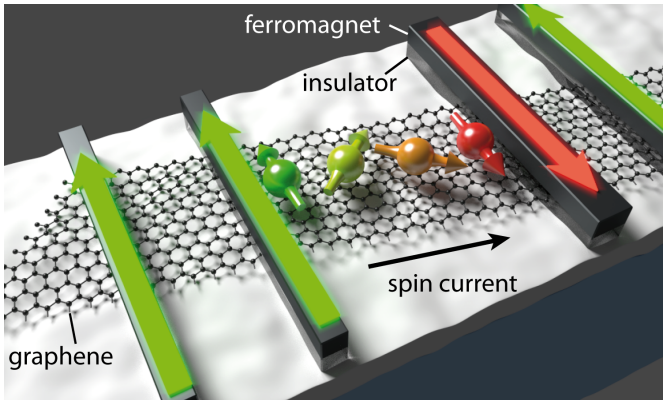
JARA Jülich Aachen Research Alliance
RWTH AACHEN UNIVERSITY
2nd Institute of Physics A

Open Bachelor-Thesis Project

Spin transport in graphene-based heterostructures of 2D materials

(Supervision of thesis can be done in either German or English language.)

One of the long-term objectives of our research is to incorporate the spin degree of freedom of charge carriers into electronic devices. This enables a completely new class of electronics, the so-called spintronics [1]. One of the most promising material in this field is graphene, which consists of only one atomic layer of carbon atoms, but is nevertheless stable and robust under ambient conditions.

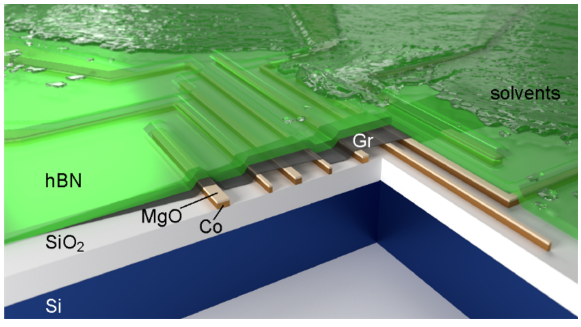


The confinement of graphene to two dimensions leads to its extraordinary physical properties, like a zero band gap or extraordinary high charge carrier mobilities. With respect to spintronics, i.e. spin transport lengths or spin lifetimes, graphene outperforms all other materials at room temperature [2], which explains its great technological potential.

To exploit graphene's potential to its fullest, it is necessary to combine it with other 2D materials to build so-called van-der-Waals heterostructures which can possess tailored physical properties [4]. The combination of graphene with insulating boron nitride, e.g., already enabled us to significantly improve the spin transport properties of graphene [2].

As a Bachelor student you will participate in our effort to improve the spin transport properties of our devices even further and to combine graphene with other 2D materials such as transition metal dichalcogenides which hopefully will enable us to create, to detect and to manipulate electron spin currents in unprecedented ways.

You will gain insight into the actual device fabrication like the exfoliation and the transfer of 2D materials, or the lithography and metallization processes. On the other hand, you will perform magneto-transport measurements in a setup which allows measurements from liquid helium temperatures up to room temperature.



Literature (freely accessible within the RWTH net)
[1] „Future perspectives for spintronic devices", J. Phys. D: Appl. Phys. 47, 193001 (2014)
[2] „Spin Lifetimes Exceeding 12 ns in Graphene Nonlocal Spin Valve Devices", Nano Lett. 16, 3533 (2016)
[3] „Graphene spintronics", Nature Nanotechnology 9, 794 (2014)
[4] „Van der Waals heterostructures", Nature 499, 419 (2013)