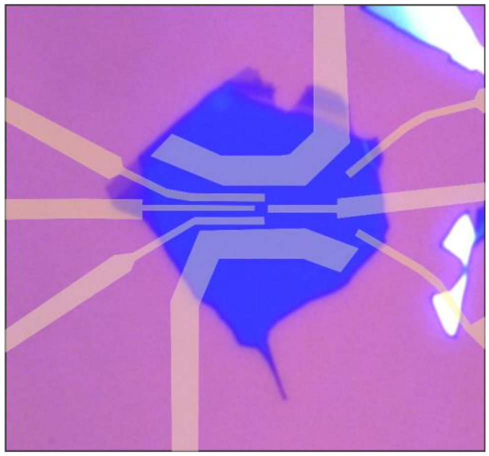
2015/2016

Masterthesis

Gate defined quantum dot in two-dimensional transition metal dichalcogenide semiconductors



Motivation

The discovery of graphene in 2004 has created a whole new field of research, which led to the investigation of other two dimensional materials such as transition metal dichalcogenides (TMDCs). A monolayer of these materials consists of a layer of transition metal atoms (Mo, W, etc.) sandwiched between chalcogen atoms (S, Se, or Te.). In contrast to graphene, TMDCs have a bandgap and hence open the possibility of using standard semiconductor fabrication techniques to define an atomically thin quantum dot purely by electrostatics. The advantage compared to traditional semiconductor materials is the atomically thin geometry and dangling-bond-free interfaces which makes it easy to combine TMDCs with various substrates. The relatively strong intrinsic spin-orbit splitting in TMDC materials offer the possibility of using these quantum dots as spin-valley qubits.

Project

In this research project we will fabricate TMDC / hexagonal boron nitride heterostructures by exploiting a dry transfer technique to build devices with extremely high quality. After defining the quantum dot by depositing electrostatic gates and source-drain contacts, we will perform transport measurements at cryogenic temperatures and explore the quantum nature of the device. For successfully accomplishing the proposed study we will work as well in the clean room to fabricate the device as at a dilution refrigerators to perform the transport measurements.

Suited for students from the Physics, Electrical Engineering and Material Science departments.

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