

# Master thesis

## Scanning Tunneling Spectroscopy of topological edge states in Bismuthene

### Outline:

Bismuthene is a single layer of bismuth atoms arranged in a honeycomb lattice being analogous to the graphene lattice (**Fig. 1**). But in contrast to graphene, Bismuthene provides a strong spin-orbit interaction leading to a topologically non-trivial band gap at the Fermi level as large as 0.8eV (**Fig.2**). This renders Bismuthene a favorable candidate of two-dimensional topological insulators, which might operate at room temperature, e.g., providing dissipationless electric current via its edge states.

### Subject of the master thesis:

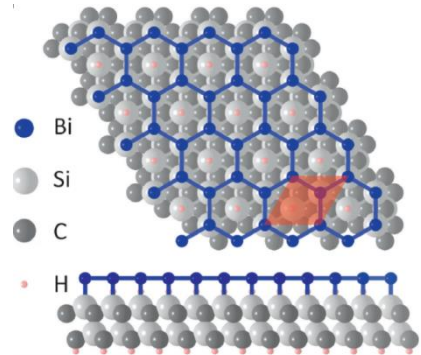
Bismuthene samples will be grown epitaxially on a hydrogenated SiC(0001) substrate [1]. The surface preparation by hydrogenation and the subsequent Bismuthene growth will be performed in-situ in a room temperature STM setup operating in ultra high vacuum (**Fig.3**). The STM will subsequently be used to probe the topologically protected edge states, in particular, at zig-zag or armchair boundaries and near defects in order to reveal the strength of the local protection of the topological edge states.

### Your skills:

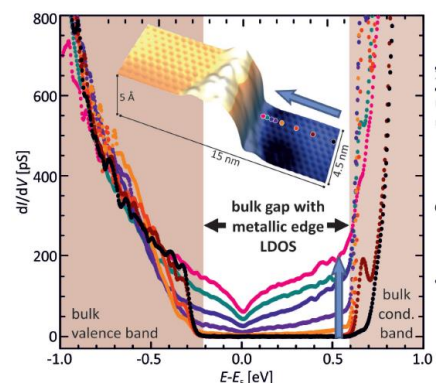
You should be technically skilled and excited about experimental approaches. Moreover, you need a solid background in quantum mechanics in order to grasp the central ideas of the topological description of solids.

### References

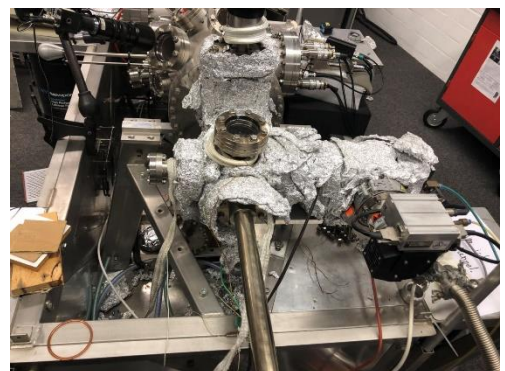
[1] F. Reis et al., Bismuthene on a SiC substrate: A candidate for a high-temperature quantum spin Hall material, Science 357, 287 (2017), [arXiv:1608.00812](https://arxiv.org/abs/1608.00812)



**Fig.1** Sketch of two dimensional sheet of Bismuthene on SiC(0001) substrate [1].



**Fig.2** Tunneling spectroscopy of Bismuthene showing edge states at substrate steps [1].



**Fig.3** Room Temperature STM operating under Ultra High Vacuum.

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