

Topic for a Master Thesis

„Exploring the structure of metavalently bonded MBE grown Bi thin films“

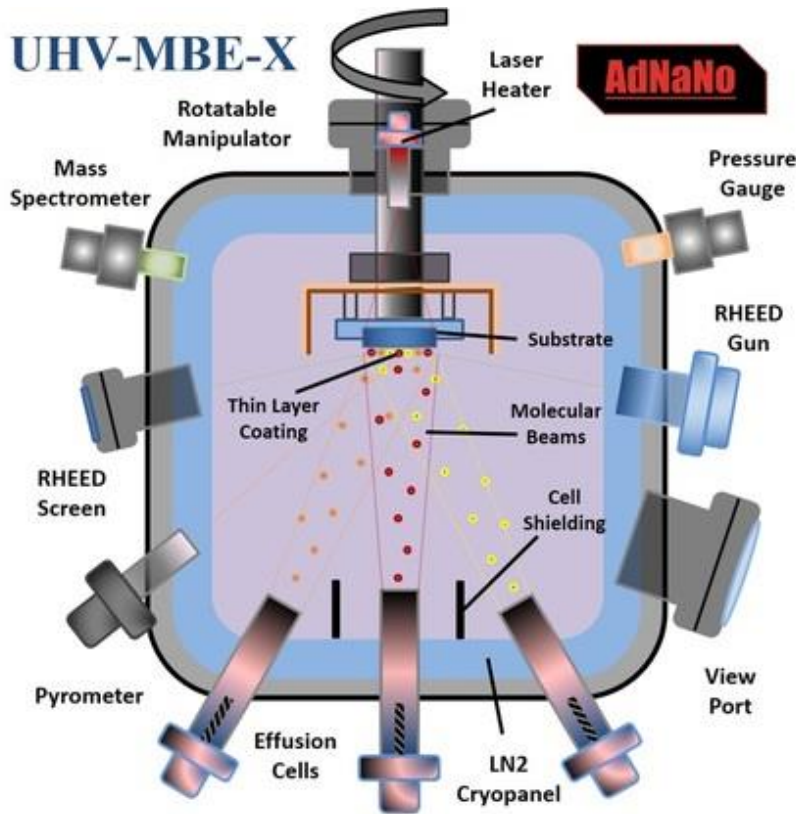


Fig 1: Principle of a MBE setup, like the one in the FZ Juelich [1].

The metavalent bond (MVB) is a newly proposed type of bond, that is fundamentally different from the ionic or covalent bond. Many examples show, that materials which possess this type of bond, are good candidates for phase change materials (PCM). These materials show a reversible switching behaviour between their amorphous and crystalline phase and yet are candidates for industrial applications like PCM based chips or hard drives. However, a good indication for a MVB system is the Peierls distortion, leading to either contraction or extension of the chemical bond between two atoms in a solid.

To continue the fundamental research in this field, the aim of the thesis is to develop a recipe for the MBE growth of Bi thin films and the exploration of the atomic arrangement within them (e.g., size of Peierls distortion), dependent of the thickness of the film.

Materials like GeTe or Sb₂Te₃ have shown, that changes in the atomic arrangement occur by reducing the film thickness. The main duty in this work will be to develop and optimize the challenging growth of Bi thin films. To this end, the MBE setup of the PCM group PGI-10 within the Forschungszentrum Juelich will be used, armed with eight different evaporation cells and an in-situ reflection high-energy electron diffraction (RHEED) setup. Additionally, various ex-situ characterization techniques like x-ray diffraction (XRD) and x-ray diffraction (XRR) of the group of Prof. Matthias Wuttig at the RWTH Aachen will be used. As a bonus the atomic arrangement of ultra-thin films can be explored, using low energy electron diffraction (LEED) as an additional in-situ technique within the Forschungszentrum Juelich.

The student should have a high interest for fundamental research, the motivation to work independently and to travel to the Forschungszentrum on a high frequency. For the latter, a bus that connects the Forschungszentrum and Aachen can be used. The thesis language can either be English or German. The everyday working language will be English though, due to the international team within the Forschungszentrum.