Cost-effective transport and storage of energy are two key factors, which lead to the development of world civilisation. Electricity is the energy form of choice for most uses, and the most effective way to transport energy to different locations. Unfortunately, huge amount of the generated electricity is lost in grid by heat dissipation and transmission limitations. High-critical temperature cuprate superconductors, which are main part of superconducting cables have a potential to enhance the grid to meet the increased demands. Remarkably, such cables can carry five times more power then copper wires with the same cross-section and exhibit considerable lower losses. However, all applications require that the high-T_c superconductor must be formed into long and flexible conductors. By itself, this is already a formidable obstacle because all high-T_c superconductors are brittle ceramics. Moreover, the large anisotropy of their physical and transport properties requires that all the crystallites in the conductors must be very closely aligned along the three crystal axes. Only then the supercurrent will flow in a basal plane within copper-oxygen planes without disturbances. The development enables precise control and create of ceramic/metal interfaces or multilayers with various thicknesses. Thanks to that fact, the superconductor could be processed in the form of an epitaxial film deposited by different methods on a polycrystalline and flexible template comprising a metal substrate (nickel- or copper-based tapes) and epitaxial oxide buffer layers. The metallic template is manufactured using two major approaches: the rolling-assisted biaxially textured substrate (RABiTS) and the ion beam assisted deposition technologies.

Copper-based substrates are the low-cost alternative for fabrication of high-T_c superconductor coated conductors. The advantages of Cu tapes are the easy formation of a sharp cube texture, they are non-magnetic, cold workable and there is no chemical interaction with high-temperature superconductors. The main disadvantage is the poor resistance to oxidation in an oxygen atmosphere at high temperatures, during the growth of the superconducting phase. Fortunately, MgO/TiN heterostructure is as a suitable barrier to both copper and oxygen diffusion during the deposition of coated conductors. The combined use of TiN and MgO is necessary to avoid detrimental copper oxidation during the growth of superconducting thin films.

In this project we plan to carry out a systematic study of an influence of thickness of as-deposited TiN and MgO layers onto quality of heterostructure. The value of thickness of both thin films where the buffer properties are maintained have not been studied before. Among many deposition methods, we have choose pulsed-laser deposition technique, because it offers advantages such as a high deposition rate, a capability of forming thin films with proper chemical stoichiometry, and an easy control of the thickness. Based on the results obtained from X-ray diffraction and transmission electron microscopy techniques, we will figure out how the thickness of thin films will affect on orientation and structure of the heterostructure. The use of advanced methods and research equipment at the disposal of the project group will allow for an in-depth understanding of a complexity present in the growth mechanisms of TiN and MgO deposited onto cube-textured copper substrate.