One of the most effective ways of materials utilization is the growth of corresponding thin films and coatings with different microstructures and properties by careful tuning processing conditions. A surface thin film or coating is an effective method to improve the durability of materials used in aggressive environments. The thickness of the overall coating is of the order of a few microns or less and hence can be used as a finishing operation for tools manufacturing with the aim to improve their properties or/and prolong their lifetime. By properly selecting the coating method and materials, the service life of a tool may be prolonged significantly and its commercial value increased.

Nowadays, the increasing industrial demand for advanced thin film material systems needed for a wide range of future technical solutions, e.g. in energy, medicine, nanoelectronics, aerospace, defense, semiconductor, and other industries, requires the development of new multifunctional thin film materials, which can meet the challenges of providing simultaneously superior mechanical, tribological, chemical and physical properties in a broad range of operating environments and temperatures.

One example of a multifunctional material class may be found within the family of multicomponent alloy systems composed of more than five metallic elements ($5 \leq n \leq 13$) in equal or near-equal atomic ratios between 5% and 35%., called high entropy alloys (HEAs). This project is dedicated to the elaboration of a new large family of functional multi-component materials called high entropy alloy ceramics (HEACs), i.e. nitrides and carbides. HEAC thin films belong to a new large family of functional multi-component materials having vast compositions and microstructures space.

By now, the functional properties of bulk HEAs and their synthesis have been extensively studied. Nevertheless, a quite small amount of experimental data is reported for HEA thin film and especially for HEACs. HEAC thin films are promising as low friction surfaces, high-temperature wear resistant surfaces, biocompatible hard and corrosion resistant surfaces etc. The problems addressed in the proposed project have not been addressed in the recent scientific studies on HEAC thin films. HEACs demonstrate unique functional properties when being stabilized as a single-phase solid solution, whose stability is highly dependent on the growth conditions, composition, configuration enthalpy and mutual solubility of the principal elements. The stabilization mechanism of HEAs and HEACs remains the most controversial in the material science community, and a clearer understanding is required. The recently developed new hybrid deposition method at the Linköping University opens new opportunities in the synthesis of HEAC thin films and is recognized as an ideal test platform for stabilization mechanism of HEACs due to its unique deposition process. Therefore, the aim of the project is the study of high-entropy alloy ceramic (HEAC) thin films based on (TiZrHfVNb) and (TiZrHfVNbTa) alloy systems grown by means of a hybrid high-power pulsed and dc magnetron co-sputtering (HIPIMS/DCMS) technique. Moreover, it is important to obtain much more useful information concerning mechanical properties and tribological behavior of HEAC thin films. Publication of the results of this scientific research will significantly improve the state of the art related to stabilization mechanism of HEACs as well as expand the knowledge in the field tribological and mechanical properties of HEACs. Obtained results will significantly increase the advancement of technical, chemical and physical sciences in fields related to synthesis, exploitation, and characterization of thin films based on HEACs. Therefore, the understanding of stability and optimization of the growth of HEAC thin films by controlled, systematic studies as well as characterization of their functional properties is a direction for future research, which will allow discovering new material solutions with superior properties and performance. Moreover, the deposition experiments will be carried out in an industrial sputtering system that will contribute to the possible applicability of the developed materials at industrial scale.