High-strength materials can find several applications including transport, aerospace, energy and construction sectors whereas usually they suffer from low ductility which significantly limits their applications. It is well known that strength and ductility cannot be achieved simultaneously in “homogeneous” metals and alloys. However, it is one of the most challenging and crucial issue to find the balance between strength and ductility of the materials. Thus, the proposed research project deals with this eternal problem trying to find a proper route to obtain materials exhibiting a unique combination of high strength and ductility.

The main aim of this project is to design, produce and characterize materials belonging to two groups of multicomponent alloys: fcc FeCoNiAlX (X=Ti, Nb, Cu) and bcc FeMnAlNiY (Y=Co,Cr,Ti) exhibiting hierarchical heterostructure at various levels starting from atomic scale to micro scale. Overall, the obtained results will allow to **answer the fundamental and challenging question** of how to find the **compromise between high strength and ductility in fcc FeCoNiAlX (Ti, Nb, Cu) and bcc FeMnAlNiX (Co, Cr, Ti) multicomponent alloys.** The heterogeneity will be introduced by chemical composition change affecting negative enthalpy magnitude and will be controlled by fabrication and heat treatment processes conditions. Then, materials will be characterized by complementary techniques including high energy X-ray, electron microscopy (scanning and transmission with high resolution mode) and electron backscatter diffraction technique. In the next step materials will be subjected to mechanical testing – tensile tests at room temperature. This part will be supplemented by in-situ tensile high energy X-ray diffraction measurements allowing to calculate dislocation density. The last task will be devoted to atomic modelling of a phase stability and physical properties of the interface between phases.

The project deals with fundamental aspects which will allow to overcome the problem of strength-ductility balance. It is also expected to enhance the application potential of alloys in large-scale industrial applications.