The main scientific objective of the project is to determine the influence of chemical and phase composition and structure of multicomponent alloys from Ti-Cr-Fe-V system on their hydrogen absorption capacity with special reference to the reversible capacity and plateau pressure. The analysis of alloy's ability to hydrogenation in a broad perspective of changes in chemical composition which determines the structure and phase composition of the alloy, will allow specifying the areas in the Ti-Cr-Fe-V system preferred in terms of high kinetics' hydrogen absorption, ease activation of alloy, satisfactory reversible capacity (2-3 wt.%) and the plateau pressure at a temperature between 20 and 80 °C) in the range pressure of 1-10 bar.
These studies will contribute to the knowledge of multicomponent Ti-Cr-V-based hydrogen storage alloys and present innovation technique by Laser Engineered Net Shaping technique (LENS) to obtain this alloys.
The variable content of elements in multicomponent Ti-Cr-Fe-V system has a basic influence on structure and phase composition and consequently. It significantly affects the ability of a material to hydrogen absorption (hydrogen capacity, plateau pressures and cycling stability). Ternary Ti-Cr-V system alloys are known as perspective materials for hydrogen storage characterized by a relatively large theoretical capacity of approx. 3,5 % wt. and their capacity to absorption/desorption of hydrogen at a room temperature. However, low capacity in the reversible range of about 1.2-1.6 wt.%, resulting from plateau pressure in the value below 1 atm is the greatest disadvantage of this material. The replacement of expensive vanadium with ferrovanadium metal (atomic ratio of Fe/V amounting to 50 %.) not only reduces manufacturing costs of the alloy, but simultaneously modifies the well-known ternary Ti-Cr-V system with additional iron element. Such replacement significantly affects hydrogenation features, affecting both the plateau pressure, total/maximum capacity, and interacting catalytically. The assessment of the impact of content/ratio of particular elements in the alloy will allow selecting alloys with specific, valuable in terms of hydrogen storage, structural and sorption characteristics
The multicomponent alloys of Ti-Cr-Fe-V alloys have not been subjected to any systematic analysis so far. Moreover, for the first time we intend to manufacture those alloys by unique technique-laser deposition LENS method. Innovative nature of anticipated analysis will allow determining both the full characteristics of those alloys and the influence of particular elements contained therein on their chemical features. Additionally, we intend to analyze and specify the relationship between microstructure and obtained hydrogen storage properties taking also into account the LENS technique which will be used for the first time.
The project is intended to significantly deepen the knowledge about the multicomponent alloys from Ti-Cr-Fe-V system in terms of effective hydrogen storage materials.