The research objective of the project is focused on the assessment of a new scientific knowledge on high temperature properties and high temperature phenomena in liquid alloys that will result in theoretical understanding of the creation of structure and properties of a wide group of iron-based alloys during their solidification from liquid state.

The project objective will be achieved through complex and systematic investigation of high-temperature phenomena taking place in selected alloys during heating, melting, casting and cooling accompanied with experimental determination of the unknown thermophysical properties of selected systems. Special attention will be paid to high-temperature interaction between liquid vermicular cast iron and selected oxides, particularly the role of temperature and contact time as well as alloying additions to cast iron alloys on their stability, reactivity and the formation of interfaces in contact with oxides, as main compounds of most refractory ceramics used for melting and casting of the alloys from cast iron family.

Research will be performed for the vermicular cast iron both without alloying additions and with additions of Cu, Mo, V, Sn, Sb and finally for corresponding cast iron/oxide systems. The comparative study of the alloys and alloy/oxide systems will be performed in solid, semi-solid and liquid states using 1) sessile drop method, 2) dilatometric method, 3) differential scanning calorimetry (DSC) and 4) detailed microstructural characterization at macro-, micro- and nano- scales by both conventional techniques (light optical microscopy, scanning electron microscopy coupled with local EDS chemical analysis, x-ray analysis) and advanced non-destructive techniques such as computed tomography. It should be highlighted that the most tests will be performed on unique high temperature experimental facility developed by the Foundry Research Institute using very specific testing procedures that are not available in any laboratory in the world.

The results obtained will permit to estimate the critical temperatures for the wide group of investigated materials and to provide chemical composition of vermicular graphite cast iron alloys with favorable combination of proprieties thanks to the possibility for the formation of its unique structure. The results obtained will contribute to the development of new scientific knowledge in the field of high temperature liquid state materials science. These studies of thermophysical properties will enrich the database of materials thermophysical properties created by the Foundry Research Institute and in the same way as before they will enlarge the unique, scientific data base of NASA (the SAO/NASA Astrophysics Data System, http://adswww.harvard.edu), which is highly cited and used by scientists and specialists in the word.
Despite significant scientific impact the results of the project will have also an important impact on the development of civilization and society since such results are crucial for the development of defect-free products by liquid-assisted processes, particularly when computer simulation approach is used in order to decrease time and cost of R&D stage of investigation needed for proper product/process development. Moreover, new experimental data may be also used for the prediction of unknown thermophysical properties of other alloys and their high temperature interaction with other oxide systems