

DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)  
"Novel in-situ Al-Zn based cast composites reinforced with particles of aluminides"

(State the objective of the project, describe the research to be carried out, and present reasons for choosing the research topic - max. 1 standard type-written page)

Casting of metals and their alloys has been present in human history for more than 4000 years. Together with the development of civilization new materials and technologies were being discovered and developed to answer demands of still growing requirements of the mechanical and service properties. Despite the development of relatively new materials like engineering plastics or ceramics, research is still focused on the metallic materials, their structure and shape. The good example are metal matrix composites, metallic foams and bulk metallic glasses.

The casting of metallic components is an important part of manufacturing industry, with relevance ranging from works of art to the highest-technology aerospace parts. The foundry industry, whose business is casting, is an essential part of any industrialized economy. This is certainly true in Poland, where the foundry industry is developing and extending its reach into products of higher added value. While there are continual refinements of the conventional metallic alloys used in cast components, the basic sectors of the industry (cast irons and light alloys - aluminium and magnesium, for example), and the basic alloy compositions are well-established and see only incremental change. Only rarely do really new, potentially revolutionary opportunities arise — this project aims to exploit the opportunity offered by the novel category of material known as "*high-zinc aluminium matrix cast composites reinforced with titanium aluminides*".

The Al-Zn based alloys with Cu addition have been developed since the twenties of XX century and now numerous metallic systems are described in literature. On the other hand, the systems containing increased Zn and Cu amounts remains beyond the main stream of research. The alloys of this system show low ductility and the addition of Cu, which is needed to improve their tribological properties, causes structural and dimensional instability which hinders practical implementation of their castings. Recent research shows that an improvement in plasticity can be achieved by grain-refinement through melt inoculation with Al-Ti or Zn-Ti based refiners and the structural instability can be reduced by partial replacing Cu with Ti and / or Mn without decreasing their high tribological properties. The latter can be additionally improved by introducing reinforcing particles.

**The main idea of this project is development of novel group of composites with high-zinc aluminium alloys as the matrix and  $Ti(Al,X)_3$  aluminides as the reinforced particles, where  $X=Zn$  and/or Cu and/or Mn. The aluminides of the same crystal symmetry as the matrix will be formed in-situ, i.e. directly in molten matrix. The obtained composites of refined matrix will have a set of unique properties, i.e. improved plastic properties, high strength and hardness, good damping and tribological properties and high structural and dimensional stability.**

In this way, the use of mentioned composites of improved properties can lower mass of the castings and thus can be cost-effective and energy saving.

This project aims to provide a basis for exploiting such opportunities in foundry practice.