The proposed research project is related to materials science and engineering fields and concerns light metal - aluminium matrix composites (AMCs), which can be used in high performance applications as they combine low density with high specific stiffness, high specific strength and high temperature stability. The potential applications include automotive and aerospace industries, which require cost-efficient, large-scale processing methods as well as low cost, lightweight materials with supreme mechanical properties.

In the project, two research teams attempt to model the phenomenon of engulfment/pushing of TiC nanoparticles on the crystallization front between the liquid and the solid during the production of the composite by the in-situ casting method in an aluminium alloy bath. This phenomenon has a significant impact on the final distribution of particles in the matrix of the composite, within the grain boundaries or inside, which in turn affects the mechanical properties. In order to reduce expensive and long-term experiments, it is planned to model this phenomenon with the use of cellular automata (CA), and then verify it with experimental methods such as in-situ casting of composites and their detailed phase and microstructural analysis. These works should lead to optimal process parameters needed to obtain an ideal microstructure consisting of fine matrix grains with homogenously distributed ceramic nanoparticles in it. Such a combination should in the future ensure the best properties of various types of composites based on aluminium alloys.

In order to develop a correct model as well as its validation, it is necessary to provide a number of physical and chemical data of the tested object and to conduct phase and microstructural analysis at the highest scientific level. Therefore, the project assumes close cooperation of scientists specializing in the fields of design and modelling of production processes, casting of composite materials, analysis of thermo-physical phenomena occurring in slurry of liquids with solids, and analysis of the microstructure and phase structure of composite materials.