Aluminium alloys are among the most frequently used in practical applications due to an attractive combination of mechanical properties, low density and corrosion resistance. Mechanical properties of such alloys are tailored by a combination of plastic deformation and heat treatment. It leads to a nucleation and growth of very fine, homogenously distribute within entire volume precipitates that bring a strengthening effect. Therefore, the final shape of product is set via plastic deformation and then mechanical properties are being established by a heat treatment. Effectiveness of this process depends on chemical composition of an alloy and details of thermo-mechanical treatment. However, because of reduction of production cost and large scale manufacturing precise control over the treatment conditions is usually neglected. Literature studies show that if thermo-mechanical processes are designed with respect to the chemical composition of particular alloy it is possible to obtain mechanical properties at the level higher than with an usual processing route. It can be linked with microstructural changes which take place during plastic deformation. They can lead to the formation of structural defect which enhance the ability of nucleation of strengthening phases during post deformation heat treatment.

The main goal of the current project is to evaluate the ability to tailor microstructure and mechanical properties of Al-Cu and Al-Mg-Si alloys by a precise control over the thermo-mechanical treatment. It will be possible due to understatning a relation between microstructure established in plastic deformation process and nucleation of strengthening phases – the main investigations thread. Each of considered alloy feature different mechanism of nucleation and growth of strengthening phases therefore various processing routes are expected. However, the new procedures will be designed in order to obtain higher mechanical properties than typical for these alloys.

To obtain these goals a different combination of thermal exposure and plastic deformation via rolling will be tested on a commercially available Al-Cu and Al-Mg-Si alloys. As a first step of evaluation of applied processing conditions a microhardness tests will be performed. Then, a detailed microstructural evaluation will be done by backscattered electron diffraction and transmission electron microscopy. The former allows to evaluate plastic deformation impact on microstructure, the latter allows to identify strengthening precipitates. Combination of these two techniques allow to link microstructure features of material subjected to plastic deformation with characterization of precipitates at nanoscale and may be used to understand relations between deformation microstructure and precipitation processes.

Results obtained in the project are expected to answer a basic questions about tailoring microstructure and mechanical properties aluminium alloys by a complex thermo-mechanical treatment. The knowledge can be used to develop practical aspects of manufacturing technology of aluminium alloys.