Despite many decades of scientific work and improved research instruments, some of the **binary phase equilibrium systems are still unknown or are only theoretically predicted or calculated**. Obstacles to the syntheses and testing of alloys are different and often caused by significant differences in the melting points of components, their reactivity with structural materials of the research apparatus, significant differences in densities (and the resulting tendency to gravitational segregation) or high vapor pressure causing intensive evaporation and sometimes even sublimation of low melting point components.

However, the fact that such alloys or intermetallic phases are difficult to be produced does not mean that they do not exist or that their properties cannot be fascinating from the science and technology point of view. Therefore, **a thorough examination of phase equilibrium systems (starting with binary ones) is extremely important for making progress in science in general.**

Alloys based on **Mg-Pt** and **Mg-Pd** systems are difficult to be produced for the above mentioned reasons. However, due to significant differences in physical properties of magnesium and platinum, they may have **very interesting properties or combinations of properties**. One of the "common denominators" linking these elements is their ability to **interact with hydrogen** – considered to be the fuel of the future. Palladium has the ability to absorb hydrogen at a relatively low temperature to form a solid solution, and palladium alloys (e.g. with silver) are used as separation membranes to purify this gas. Platinum, on the other hand, although it does not absorb hydrogen, is an excellent catalyst - used on the surface of PEM membranes in fuel cells to separate hydrogen molecules into H^+ ions. Magnesium at elevated temperatures (300 – 400 ºC) first forms a solid solution and then magnesium hydride, which can store reversibly up to 7.6 wt. % of hydrogen. Reversible means that, hydrogen from hydride can be thermally desorbed and later on formed when proper hydrogen pressure is applied. Some of alloys or mixtures of these elements (Mg-Pd, Mg-Pt) have already been measured and show affinity to hydrogen. For this reason, it is highly appropriate to undertake **systematic** studies to determine the ability of those group of alloys to **interact with hydrogen**.

The main aim of the project is to determine thermodynamic and physicochemical properties of alloys from Mg-Pd and Mg-Pt binary systems, and then to subject the obtained alloys to studies showing how they are able to react with hydrogen, and what are the properties of products of that reactions. In order to achieve these objectives, the following actions are proposed:

1. Preparation of alloys from Mg-Pd and Mg-Pt systems using both melting and mechanical synthesis in a ball mill (depending on the possibilities).
2. Investigations of thermodynamic properties of obtained alloys.
3. Modelling of physicochemical properties such as viscosity and surface tension of alloys from Mg-Pd and Mg-Pt systems on the basis of obtained thermodynamic data.
4. Investigations of phase transformations taking place in the obtained alloys during their heating and cooling.
5. Determination of formation enthalpies of intermetallic phases from Mg-Pd and Mg-Pt systems using ab-initio calculations.
6. Calculation of phase diagrams of proposed binary systems by CALPHAD method and ThermoCalc and/or Pandat software.
7. Investigation of the ability of selected alloys from Mg-Pd and Mg-Pt systems to react with hydrogen.
8. Investigation of properties of formed hydrides.

Obtained experimental enthalpy values of intermetallic phase formation and mixing enthalpy values of liquid alloys from Mg-Pd, Mg-Pt systems will be entered into the free Entall database available on the website of the Institute of Metallurgy and Materials Science of the Polish Academy of Sciences: www.imim.pl.