Materials with a structure typical for garnets have been arousing great interest due to their unique combination of magnetic, electrical and optical properties. Among various types of garnets with that type of properties, yttrium-iron (YIG), terbium-iron (TbIG), gadolinium-gallium (GGG) garnets and composites based on them can be primarily distinguished. An extremely interesting group of materials with a garnet structure are those containing metals with ferromagnetic properties, mainly iron. Their basic properties, in contrast to pure metals, is low electrical conductivity. That property has a significant impact on low values of losses associated with eddy currents and is one of the main reasons why ceramic magnetic materials are used in areas where these losses must be minimized.

The subject of planned research is a material with a garnet structure – an yttrium-iron garnet YIG ($Y_3Fe_5O_{12}$), characterized by excellent electromagnetic properties, that include low dielectric loss, narrowing of the resonant line width in the microwave area, chemical resistance. Such wide spectrum of properties of YIG results in application: use in passive microwave devices (as an amplifier), phase shifters, circulators, insulators, etc. The structure of garnet allows for many substitutions with rare earth, alkaline or other metals. This creates the possibility of obtaining a number of solid solutions with variable and controlled magnetic and electrical properties. In order to obtain material for specific applications it is necessary to control the synthesis conditions or undertake appropriate doping. An yttrium-iron garnet can be obtained using many methods, however, the literature data does not indicate the possibility of obtaining dense polycrystalline sinters of this material. Analysis of the literature indicates that the current research focuses only on the synthesis of YIG in the form of single crystal or polycrystalline YIG in the form of thin layers. In order to obtain powders with the desired morphology and dense YIG sinters, a number of methods are used. These methods are known as *soft chemistry* and allow to obtain more homogenous or even monophasic substrates. The most important methods include coprecipitation, the sol-gel method, synthesis from microemulsions, the organic precursors method or the hydrothermal method.

In this project, it is planned to develop effective methods that have not been used so far, allowing to obtain these dense polycrystalline yttrium-iron garnet sinters using homo- and heterogeneous nucleation. Particular emphasis will be placed on detailed characteristics of electric and magnetic properties of obtained materials. Results will allow a better understanding of the effects and mechanisms occurring during reaction sintering and the effect of nucleation on the kinetics process. It can have this effect on a wide range of applications, which will affect the development of magnetic ceramic materials and increase knowledge in the field of layered materials based on YIG. An additional advantage will be the development of research on materials used as domain memories (YIG-GGG) and development of this application branch.