In applications, where the fundamental and essential property is transparency traditionally non-crystalline materials such as glasses and polymers are used. The advantages of this type of materials are relatively low cost of manufacturing and easiness of large and complex shapes production. These materials have also some disadvantages which include relatively poor thermo-mechanical properties and sometimes insufficient chemical and physical stability. Single crystals can possess great mechanical and thermal properties. However, their growth requires sophisticated facilities and is very time consuming, thus leading to expensive products that are mainly used in cases where price is not of great significance. Other problems of single crystals include difficulty of large-scale production, shape, size and composition restrictions.

The solution to the problems outlined above appears to be transparent ceramics materials that combine the advantages of the single crystals and glasses i.e. cost-effectiveness, ability for large-scale production, feasibility of shape controlling and on the other hand high chemical and thermal resistance and good mechanical properties which makes them to be the ideal candidates for applications operating in extreme environments. In this respect, transparent ceramics become more and more important last years.

An advantage ceramic manufacturing process over single crystals is a feasibility of obtaining composite multilayered structures aimed at optimizing of the thermal properties and lowering optical losses of laser materials. To this kind of materials is dedicated the proposed project.
The proposed project aims to produce a composite, transparent ceramic materials based on yttrium aluminum garnet undoped (YAG) and doped with neodymium (Nd:YAG) or chromium (Cr:YAG). Layered composite material will be produced by laminating and sintering of ceramic foils of different chemical compositions. An attempt will be made to fabricate four kind of composite (YAG/Nd:YAG and Nd:YAG/Cr/YAG) materials, as shown below.

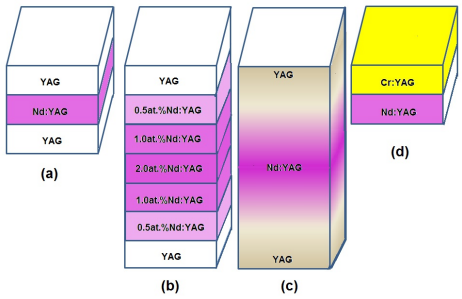

Fig. 1. Schematic representation of the four types of ceramic materials planned to be produced within the framework of the proposed project: a) YAG/Nd:YAG composite (undoped layers on the faces of neodymium doped laser material), b) and c) gradient doping materials with a step or smooth change of the composition d) Cr:YAG/Nd:YAG composite

The resulting composite materials will be subjected to comprehensive spectroscopic studies. Measurements of transmission spectra, emission and fluorescence dynamics will be performed. For Cr:YAG samples nonlinear absorption studies will be conducted. Heat distributions in the optically pumped composite materials will be determined using a thermographic method.

The project is aimed at basic research necessary for explanation of the relationships between optical and thermal properties of transparent, multilayer ceramic composite laser materials and technological conditions of their production, composite system geometry and chemical composition of individual layers