Educational project summary

The possibilities of modern industrial equipment and laboratory equipment depend to a large extent on the advancement and quality of the materials used and the extent of their use.

Their existence allows for technological development, and even the treatment of a growing number of diseases. They are also one of the main driving forces of modern economy, science and technology in the world. That is especially noticeable in the areas of modern science which grow the fastest, including e.g.: electro-optics, magneto-optics and quantum computing.

Despite that, scientific development lags behind the need to satisfy the most basic needs, because the materials used in construction are limited.

Therefore, there is a strong need for research on a new advanced materials that will allow to remove the barriers to qualitative development of civilization, and for cognitive research. The sciences listed above as well as many other branches of science components are used that use the basic physical properties of matter. Within the many possible devices the quality and performance of which is highly dependent on the applied structural materials, there are optical isolators and circulators. Those elements belong to the group of optically passive devices.

They are very important elements used in any design that uses electromagnetic radiation, in particular laser beam and polarized radiation. The simplest such element is an optical sight-glass as part of a heating chamber, a furnace or any device that uses high temperatures and reactive gases. It is possible to e.g. introduce a laser beam through the sight-glass, which gives many empirical possibilities. Very often, producers are forced to give up a sight-glass for technological reasons because even quartz glass has a largely insufficient softening temperature level. Advanced optical devices using the Faraday effect include optical isolators. Those devices allow light to run only in one direction, i.e. they act as a check valve. Their task is to prevent the return of electromagnetic radiation reflected from an element to its source, which protects the devices (in particular diode lasers, high power lasers) from instability and even destruction. The novelty of the presented project consists in the production of and new empirical knowledge on the new group of transparent ceramics. Experimental results from the implementation of the main scientific objective – which is gaining detailed knowledge of the physicochemical properties, influence of particular dopants, and chemical phenomena occurring in the new class of ceramics – will be an original contribution to two major areas of research: material engineering and physics. That is justified with the wide range of the proposed experimental studies, allowing for gaining full knowledge of the extremely important physicochemical properties of powders and sinters. The empirical data will be supported with "ab inito" computer calculations.