The research undertaken in this project is concerned with chemical compounds in the form of crystal with addition of small amount of additional atoms of a different element, namely manganese. When such a material is provided with extra energy, for example in the form of the light of higher energy, light emission from the added element is very common. This is not only the case of manganese, but a large group of elements.

Manganese in the crystal (the so-called crystal matrix) substitutes certain atoms, which are normally found in the matrix, and forms chemical bonds with the atoms of the matrix in its nearest surrounding. Due to the fact that manganese is a metallic element, its outermost electrons are only weakly bonded with the atom. As a result, they can easily transfer from manganese to other atoms in the surroundings. It can be conceived as follows: there is a positive Mn^{4+} ion in the crystal instead of a neutral manganese atom.

The light emission from the atoms or ions is related to electron leaps between energy levels of different energy, during which the energy difference between these levels is emitted in the form of light (photons). A specific property of manganese is that the light emission (luminescence) from its ions, observed in the crystal, does not appear when the ion is outside of the crystal (in the free state). It is said that the electron transitions in the manganese ion are forbidden (i.e. they are extremely improbable). The role of the crystal (specifically, the nearest surrounding of the manganese ion in the crystal) is to increase the probability of the electron transfers between the energy levels, which results in the visible luminescence. This is related to the fact that the probability of forbidden transfers increases greatly when the surrounding of the ion has low symmetry (e.g. the atoms surrounding the manganese are not entirely symmetrically arranged). Similarly, the probability of manganese luminescence increases significantly as a result of crystal lattice vibrations.

The aim of the project is to determine the influence of the symmetry changes that can be artificially induced in the crystal on the manganese luminescence. For this purpose, the crystals doped with manganese are subject to high pressure with the use of small diamond anvils. These can be used to produce pressure of the order of several thousand atmospheres, which is enough for the atoms to slightly displace. Under high pressure the manganese surrounding is prone to distortion which in turn alters the energy (color) and intensity of the emitted light.

Materials doped with manganese are applicable as phosphors, i.e. materials which emit light of the designated color (red, in the case of manganese) as the consequence of the additional energy (for example in the form of higher energy light). This is the case in the LED lamps, where the blue light emitting diode partially excites green and red luminophore (that included manganese) which results in the white light.

As regards the posphors industry, precise control over such properties as color of the emitted light and light intensity (which depend highly on the manganese surrounding in the crystal) is vitally important. Thus, detailed insight into the phenomena occurring in the crystal as a result of changes in the interatomic distances and atom arrangement can contribute to the synthesis of materials with better practical parameters.