Zirconia exists in three polymorphic modifications. The low temperature one shows monoclinic symmetry, the intermediate temperature is of tetragonal structure. At still higher temperature cubic modification exists. Numerous publications are devoted to the tetragonal to monoclinic (t→m) form transformation. This transformation is of martensitic character and is attributed to the small volume increase (3-5%). This fact is of utmost importance in the case zirconia based materials of exceptionally good mechanical properties. The only condition to achieve such material is retention of tetragonal phase in the dense polycrystalline material. It is possible if grain sizes of this material are not too big. Another factor is introducing to zirconia some oxides forming with ZrO_2 solid solutions. List of such oxides is vast. For the purpose of this work Y_2O_3 and MgO are selected.

Investigations od out team have shown that solid solution powders of nanometric particle size can be manufactured by subjecting amorphous zirconia gels to the hydrothermal treatment in an autoclave at temperatures up to 250^{o}C. If the process is performed in pure water nanometric powders of particle sizes about 10nm result. Due to so small particle sizes such powders show extremely high sintering ability. However, crystallization performed in aqueous NaOH solution results in elongated particles, much bigger than those crystalized in water only. The concept of this project consists in introducing the elongated pure zirconia particle into the matrix of nanometric solid solution particles. During the heat treatment of such system two phenomena occur. One is diffusion of Y_2O_3 and MgO from the nanometric matrix to elongated ZrO_2 particles. Simultaneously grain growth, first of all nanometric zirconia solid solution will occur. This process will be governed by the elongated grains; Under such circumstances the newly formed grains should be, from the crystallographic point of view, oriented like the starting elongated particles. These phenomena lead to the decrease of the solute concentration in nanometric matrix. Simultaneously concentration of these additive increases in the elongated particles. So, the study is necessary to find proper solute concentration which leads to the tetragonal phase existence in the both parts of the system. The most innovating character of this project is based on ordering the elongated particles in one direction. Thanks to this a material of anisotropic mechanical properties should be achieved. It should be noticed that such concept is for the first time shown in this project. According to our best knowledge nobody as yet tried to perform such research. Realization this concept needs solution of several practical and basic problems.