The objective is to develop the dual laser-induced crystallization technique for non-doped and RE doped (Er, Sm, Dy, Pr, Tm, Ho, and co-doped Yb) glass-ceramic (GC) waveguide fabrication from the congruent and incongruent $TeO_2$-$GeO_2$ (TeGe) oxyfluoride ($BaF_2$, $SrF_2$, $GdF_3$, ZnTe, GeTe crystals) glass matrix compositions. The research problem concerning the development of a crystallization mechanism leading to the fabrication of transparent (VIS-NIR) ceramics glass waveguides started to be essential to develop new or more powerful laser sources. The general work plan is pointed out in the Work Packages (WPs) characterized below. Specific research goals are identified in the tasks. WP1: Determination of GC formation mechanism in the congruent and incongruent oxyfluoride TeGe glass hosts with non- and RE doped ions. Task 1.1 Fabrication and then analysis of the chemical composition, microstructure, and structure of host glasses (EMPA, XRD, SEM-EDS, MIR, Raman, MAS NMR spectroscopy) Task 1.2 Crystallization characteristics of the non- and doped RE ions glasses using differential scanning calorimetry (DSC). Task 1.3. Optimization of the parameters of the controlled dual-laser-induced crystallization process in non- and doped RE ions host glasses (continuous-wave $CO_2$ and femtosecond lasers). Task 1.4 Microstructure and structure analysis of oxyfluoride glass-ceramic samples (GID, XRD, SEM-EDS, HR-TEM, Raman, MAS NMR spectroscopy, IR in the THz region). Task 1.5 Spectroscopy analysis of RE ions in TeGe GC. Investigation of excitations, and luminescence spectra as well as decays curves of rare-earth doped TeGe GC. Moreover, second-order electrical susceptibility will be measured for non-linear crystals in GC samples. WP2: Formation of the crystals with RE as seed nucleus in TeGe GCs. Task 2.1 Analysis of energy transfer of RE based on luminescence spectra of RE doped samples, Task 2.2 Analysis of the RE ion`s role in crystallization (DSC measurements). Task 2.3 Dual-laser-induced crystallization. Task 2.4 Microstructure and structure investigations of GC TeGe (GID, SEM-EDS, HR-TEM, Raman, MAS NMR, and IR spectra in the THz region). Task 1.5 Spectroscopy analysis of RE ions in TeGe GCs. The same as Task 1.5 in Work Package number 2. WP3: Fabrication of the TeGe GC waveguides. Since the discovery of heavy metal oxide glasses (HMO), the tellurite and germanate glasses doped with RE have a growing interest in a wide range of applications such as lasers, optoelectronics, broadband optical amplifiers. Crystallization of HMO tellurite and germanate glasses has been investigated as a technique to improve their properties and functionality such as photoluminescence and second-order optical nonlinearity. Transparent oxyfluoride glass-ceramics (OxGCs) with fluoride nanocrystals doped with RE have received attention for use in photonic. Despite the many advantages of tellurite and germanate oxyfluoride glass-ceramics doped with RE, there are few reports in this field in the literature. In recent years, laser irradiation has received attention as a new tool for controlling crystallization. Laser-induced crystallization in tellurite and germanate glasses are still fragmented and not well investigated in contrast to silica, phosphate, and chalcogenide glasses. In literature, the $LaBGeO_5$ system is a model one, which still focuses the attention if HMO glasses are considered. This is because this glass easily forms a congruent ferroelectric crystal structure with large nonlinear optical properties. Moreover, the presentation in the literature of laser-induced crystallization by using only one laser has its limitations. Even though the continuous-wave (cw) laser allows to obtain crystals of better quality than with the femtosecond laser (fs), its limitations arise from creating only 2D waveguide structures. Most irradiation conditions presented in the literature on femtosecond laser-induced crystallization produce bilateral-symmetric lines with cross-sections due to too high temperature for crystal growth at the fs laser heat source in the center. It is proposed in the project that more consistently uniform single crystal growth results could be achieved by using two lasers as the excitation source simultaneously. The use of a continuous laser would make it possible to reduce the power of the femtosecond laser, which will have a direct impact on crystal growth. It provides useful guidelines for designing the large parameter space of cw and fs lasers crystallization to find conditions that maximize the potential to produce high-quality uniform single crystals, and it represents a significant step toward practical application of the technique. The overall added value of the project will be 1) explaining aspects of knowledge in the field of crystallization of glasses by using two lasers at once; 2) detailed characteristics of the oxyfluoride glass-ceramics from the $TeO_2$-$GeO_2$ system; 3) manufacture of active GC structures (planar and fiber waveguides), and 4) obtaining active laser transitions in RE dopants in a low-phonon environment. Significance to the knowledge can be visualized by the following milestones of the project: 1) GC formation mechanism in the TeGe host delivering the understanding of the TeGe structure changes in the GC materials after dual laser excitation determination of the non-radiative phonon absorption usage as a mechanism for nucleation; 2) Determination of the role of RE ions in the energy transfer and crystallization leading to optimization formation of the crystals with the RE as a seed nucleus, 3) TeGe GC waveguide fabrication conditions and optimization properties of the passive waveguide fabrications in terms of attenuation and nonlinear properties.