The research area of the project is in the field of photonic materials engineering. The scientific problem concerns the development of functional hybrid optical materials, such as **transparent glass-ceramic optical fibers, which doped with lanthanide ions obtain unique luminescent properties for photonic applications**. Generally, the glass-ceramic material consists of glass and suspended in amorphous volume nanocrystals doped with lanthanide ions. The controlled degree of crystallization is carried out in the process of heating materials at a specified temperature and at the right time of the experiment. Due to this, the glass-ceramic optical waveguide structures thus get better emission parameters (high quantum efficiency) compared to analogous amorphous structures, while maintaining the high optical quality. There are currently two main methods of producing nanocomposites. The first one, where optical fiber is made with classic drawing and then is annealing in this same way as in volume materials. This method is characterized by the multistep process, wherein each stage of the experiment the material is thermal treated (melting → bulk annealing → drawing fibers → heat-treatment). As a result, this process is very complex and controlling the size and density of nanocrystals is almost impossible. In addition, there are problems with their use in practical applications, because those optical fibers are brittle. Another way is the direct doping method of glass, which allows simplifying the process of nanocomposite material fabrication in a single step, where nanocrystals doped with lanthanum ions are added into supercooled liquid glass. As a result, hybrid material with high nanocrystals density is received, but also strong inhomogeneity, resulting from nanoparticle aggregation and partial degradation is observed. However, processing those materials into optical fibers leads to further degradation of the nanoparticles and thus decrease luminescent properties.

Based on literature research and preliminary experiments the hypotheses that appropriate selection of the chemical composition of the glass, nucleators and the crystallization rate allows for obtaining transparent glass-ceramic optical fibers doped with lanthanides directly in the drawing process (one-step). **A crucial research point is the development of a drawing-up fiber technique from supercooled liquid zone liquid with a high density of nucleating atoms while controlling the growth rate of nanocrystals**. This is a new topic about the optimization of drawing-up of glass-ceramic optical fibers with a high volume of nanocrystals and controlled geometrical dimensions to preserve their functionality. Project results are a set of basic research that enables the development of GC optical fiber with high-quantum efficiency for high-power fiber lasers, functional light converters and a number of many photonic applications.