This project is aimed to investigate still unexplored mechanisms responsible for a laser-induced white-light generation from a graphene based hybrid materials including graphene ceramics, graphene flakes, foamed graphene and metal nanoparticles decorated graphene foam. In course of our previous studies we have found that for some special conditions a laser beam may be able to excite a various types of materials like lanthanide doped oxide nanoparticles, plasmonic nanoparticles and carbon based materials and produce an intense broad-band emission whose behavior is not consistent with the black-body radiation theorem. We have found that the broad-band white light emission is characterized by an optical power threshold point after which the light emission is observed. It was also noticed that the white-light emission may be generated using a various wavelengths of the excitation laser sources allowing one to have large flexibility in utilization of this phenomena. Moreover, the white-light emission was found as a rather low temperature process for which the emitting sample's temperature is typically lower than 400°C. The temperature was measured directly from the surface of emitting sample using a nano-thermometers which were placed at the sample's surface. Within this project we would like to investigate a number of various graphene based materials including the graphene, foamed graphene, foamed graphene decorated with metallic nanoparticles and graphene foam decorated with a diamond powder to get deeper insight into the mechanisms of responsible for white-light emission. We would also like to get a closer look on the mechanism of electron emission from the excited samples, showing that the emitted electrons may play a crucial role in generation of the white-light emission. Getting a deeper insight into the electron emission mechanisms stimulated both by the thermal and electric field one would be able to optimize the emission phenomena in terms of long-term stability and maximal efficiency.

Tasks proposed in the project include synthesis of new graphene based hybrid materials and their comprehensive physico-chemical characterization in terms of applicability for the white-light generation. All of the proposed tasks will be performed in the Institute of Low Temperatures and Structural Research of Polish Academy of Science (INTiBS PAN). The INTiBS PAN has got all necessary infrastructures to perform fundamental studies described in the project. Research methodology includes the use of wet chemical methods for synthesis of the materials. The as prepared materials will be characterized by the electrical measurements i.e. transport properties, complex impedance spectroscopy, electron emission as well as the optical spectroscopy including absorption and photoluminescence spectroscopy.

It is important to note that the phenomena proposed in this project is characterized by a number of unique properties that may be useful to the market. At first, the light is generated by light so it is a process of light conversion. It may be very important for any application where conventional electric approach is dangerous due to the electric shock i.e. water environments for which galvanic separation is compulsory as well as the spark safe flammable environment. Free space laser light propagation or application of optical fibers is the solution of choice for the new phenomena. The white light is also characterized by a broad band emission and is not dependent on the laser excitation wavelength. This property allow one to apply a cheap and miniature semiconductor laser diodes opening the way for fabrication of a new type of light sources. The next feature is that the white light emission is additive. It is observed that white light emission appears from the surface of excited sample. Exciting the sample by N laser beams result in a N times intensified white light emission. This feature is very useful from the technological point of view. From the commercial point of view extremely useful is the fact that the white light emission is almost invariant on the ambient temperature. Due to this fact, the new light sources may work stable in harsh conditions and very low temperatures what is hard to achieve using conventional light sources.