The treatment of acute lymphoblastic leukemia (ALL) is based on the inhibition of cancer cells growth by deprivation of L-asparagine (L-ASN). L-asparaginase (L-ASNase) introduction into the human organism causes a decrease in the L-ASN concentration in blood. In ALL cells, protein synthesis is inhibited, which in turn causes cell cycle arrest in the G1-phase and ultimately the cell death. For the therapeutic purposes, L-ASNase is received from *E. Coli* and *Erwinia Chrysanthemi* bacteria. Due to the fact, that the enzyme administered to the patient is derived from a foreign organism, the human immunity system recognizes it as a foreign protein and starts the production of anti-enzyme directed antibodies. It initiates allergies and the complete inactivation of enzyme. The side effects of that treatment include: thrombosis, pancreatitis, hyperglycemia, liver disorders and anaphylactic shock.

There is a need for the discovery of effective method allowing to improve the L-ASNase catalytic properties. However, there are only scarce studies on the L-ASNase immobilization. In the literature from last few years, only some publications exist on the L-ASNase immobilization on various carriers. The most common supports are polymers, however there are also reports on the organic and inorganic carriers. Unfortunately, only L-ASNase-PEG conjugate, that also has some disadvantages and side effects, is applied in the ALL therapy.

Therefore, the primary purpose of the project is the synthesis of the effective and active, as well as resistant and stable carbon nanomaterial-L- ASNase conjugate for potential application in anticancer enzymatic therapies. This will be realized through developing a method of effective L-ASNase immobilization on the obtained and modified by us carbon nanocarriers, what at the present state of knowledge is a novelty. Immobilization will be conducted according to two different mechanism:

- physically by the adsorption;
- chemically with formation of the bond between carrier and enzyme;

using the nanocarriers such as: graphene oxide (GO) and carbon quantum dots (CQDs) synthesised by different methods, and commercially available nanodiamonds (NDs), selected on the basis of differences in structures and surface chemistry, as well as their confirmed high biocompatibility.

Next, obtained conjugates will be characterized in terms of their catalytic properties (activity, stability, selectivity, pH and temperature dependence). Also, the effect of applied nanocarriers on the spatial structure of protein, will be determined. For this aim, the available methods (IR, Raman spectroscopy, NMR) and external research (circular dichroism) will be used.

To determine the anticancer properties of the selected systems, the *in vitro* study will be performed using human ALL-derived cell line.

It is assumed that enzyme immobilization on the carbon nanocarriers increases enzyme stability, resistance for the environmental factors (antibodies, change of pH and temperature), and will allow for the controlling enzyme catalytic properties. Moreover, the enzyme immobilization should decrease its negative effects to normal healthy cells of the human organism. It is assumed, that the results of the research, which will be obtained during the project, will allow to broaden the use of nanomaterials for medical applications. It will contribute to expand the possibilities of the design and creation of effective drug delivery systems, primarily for anticancer therapeutics.