The scientific aim of the project is to verify and understand the photocatalytic properties of novel two-dimensional (2D) structures MBenes in the decomposition of the antibiotics solution with sunlight, simulation white light, and UV light as well as reused catalyst after the process.

The MBenes are novel two-dimensional (2D) structures, prepared during the synthesis of the atomically laminated ternary transition metal borides MAB, in which M is an early transition metal, A stands for an IIIA, and IVA group element, and B is a boride. MBenes were introduced in 2015 by Ade and Hillebrecht and still require analysis, especially methods of their preparation and optical properties. The excellent results of the preliminary research of MBenes motivated me to the new study. Firstly, I observed perfectly absorbs light in the entire visible light spectrum of MBenes. Obtained result of absorbance was utilized to calculate direct and indirect bandgaps of prepared materials. These excellent properties are an effect of ultrathin oxide layers, formation with oxidation of M and B in these unique 2D nanostructures.

Firstly, I prepared preliminary research, in which we used MBenes as photocatalysts in decomposition dyes such as methylene blue and commercial textile dyes. Excellent results of dyes purification, motivated us to prepare new research, with antibiotics as compounds with toxicity and hazardous properties to the environment and human health. The photocatalysis process will be carried out with model antibiotics and mix the two most popular antibiotics used in medical therapy. What's more, the photocatalysis process will be prepared in various light energies such as UV light (365 nm), violet (395 nm), cyan (500 nm), amber (595 nm), blue (457 nm), green (523 nm), red (625 nm), white light (400-700 nm) to choose the most efficient irradiation and save energy. Additionally, research will also be carried out with sunlight to initiate environmental conditions and adapt the process to industrial applications. To analyze the efficiency of the process we will study absorbance light and the concentration of carbon and nitrogen in our samples. Our process will be concentrated on using light irradiation as a source of energy to generate the reactive oxygen species. Obtained the reactive oxygen species will react with antibiotics to prepare simpler forms of compounds and are less dangerous to the environment. What's more, we identify of presence and activity of reactive oxygen species using a bromocresol indicator solution. Reducing the toxicity of antibiotics will be analyzed with the popular natural bioindicator - green microalgae *Raphidocelis subcapitata* and planktonic crustacean *Daphnia magna*.

After the process, we will separate the MBenes from the post-process solution to analyze the influence of photocatalysis on the material. Thus, we will carry out an analysis of the MBene's structure, stability, morphology, and surface chemistry before and after the process. Additionally, the shape and size of photocatalysts using a dynamic image analyzer will be studied while the dynamic light scattering to check changes in hydrodynamic diameter on MBenes. The last step of our analysis will be an analysis of the stability of the material. The photocatalysts will be regenerated and reused in the process, to save the raw materials and energy.

What's more, we will utilize previous experience in synthesizing of MBenes and their analysis. The obtained results will be compared with other 2D materials and will make significant progress in the study of the unknown and unusual MBenes.