Nowadays, the global energy supply is among the biggest technological challenges, because the rate of worldwide energy consumption is still rising due to the growing global production and population. In contrast, our major energy resources still originate from limited and non-renewable fossil fuels, such as coal, oil and natural gas. Furthermore, the combustion of these fossil fuels produces carbon dioxide evolving to the atmosphere, which causes a global warming, increase in ozone hole, production of acid rain and many serious climate changing. Therefore, seeking renewable, clean and carbon-neutral alternative energy resources is urgently needed to limit our dependence on fossil fuels. Solar energy is widely accepted as a free, abundant and endlessly renewable source of clean energy, which could meet current and future human energy demand. Thus, the harvest and conversion of solar energy into a usable energy form is highly desirable. The perfect renewable source of clean energy is hydrogen which can be produced from water splitting by utilizing a solar energy. The process, called photocatalysis, requires utilization of a photocatalyst – a material that can be excited by solar radiation leading to creation of electron – hole pairs, which participate in oxidation-reduction of water producing oxygen and hydrogen.

So far, lots of visible light-active photocatalysts have been explored [among others titanium compounds (TiO_2 doped with metals and metal compounds, $H_2Ti_3O_7$, $Sm_2Ti_2S_2O_5$, $HTiNbO_5$ and others), Pt-WO_3, Pt-$SrTiO_3$, graphene and graphene nanocomposites with metals and semiconductors ((TiO_2, TiO_2/Pt, CdS, ZnO, VS_4, Ag/TiO_2 and others)], however, the efficiency of the water splitting is still insufficient. Moreover, most of these materials are expensive and instable during photocatalytic water splitting.

In 2009 the group of Wang proposed utilization of graphitic carbon nitride as the photocatalyst for water splitting under visible light. The benefits from utilization of this material are low cost and simple methodology of production, chemical and photocatalityc stability during photocatalytic water splitting. Since then, tens of papers concerning graphitic carbon nitride exploitation in photocatalytic water splitting under visible light have been reported. Nevertheless, enhancement of the process efficiency is still required.

The aim of the project is the development of a photocatalyst based on graphitic carbon nitride for photocatalytic hydrogen production in the process of water splitting. Study on influence of preparation and modification of graphitic carbon nitride on properties of the obtained materials that are crucial for photocatalysis will be performed. The following properties will be examined: morphology and structure characterized with different spectroscopic and microscopic tools, absorption of solar light which consists of approximately 38% of visible radiation, band gap energy, which determines the range of radiation wavelengths allowing excitation of the photocatalyst, and lifetime of photoexcited electron – hole pairs, which participate in photocatalytic reaction leading to production of hydrogen and oxygen. Graphitic carbon nitride will be modified with materials that are very promising to enhance the efficiency of the photocatalytic water splitting. It will be modified with graphene, graphene quantum dots, metals and metal compounds. Moreover, the influence of the photocatalytic process parameters on its efficiency will be examined. The effect of the photocatalyst concentration, type and concentration of electron donors/acceptors, which will be used as mediators for photocatalysis, will be explored.