The goal of this project is to design modern, alternative materials with catalytic properties based on nitrogen-doped carbon dedicated for clean technologies (*fine chemical* production and electrocatalysis).

In particularly, for the preparation of heterogeneous N-doped carbon catalysts we will use biomass – carbohydrates as an attractive carbon source. Carbohydrates will be converted into ionic liquids (ILs) what will improve their thermal stability and decrease vapor pressure resulting in reduce mass loss before the beginning of the decomposition process. Additionally the structures and properties of the final carbon materials will be controlled at the molecular level through rational design of the ionic precursors by virtue of their structural diversity. Incorporation of the nitrogen rich moieties as the cation or an anion will provide nitrogen doping, while surface area will be controlled by use of anions acting as pore generating agents. Due to intrinsic nitrogen-containing nature of most ILs, the *in situ* doping of as prepared carbonaceous materials during the carbonization process will be accomplished without need for use of additional doping agent.
These new carbohydrate IL derived N-doped materials constitute an important novelty of our proposal, not reported in the literature. Carbohydrate based ILs can be considered as all-in-one precursors for N-doped carbon combining properties of carbohydrates, like high carbon content and the ones of ILs, like high thermal stability, negligible vapor pressure and the possibility to incorporate nitrogen rich moieties as cations or anions.

N-doped carbon materials will be obtained by carbonization of carbohydrate precursors. With the position, type of carbohydrate modification and use of different functional groups, the properties of carbon catalysts can be finely tuned. The study will involve designing of new materials, their characteristics including the influence of the precursors structure on the properties of final CMs (carbonization yield, specific surface area, type of pores, content of heteroatoms, nitrogen functionalities, graphitization degree and thermal stability) and study of their catalytic properties in model electrochemical reaction (oxygen reduction reaction) utilized in supercapacitors and fuel cells. The most promising CMs will be further modified with metal particles or enzymes and their catalytic performance will be studied in classical chemical processes like: Baeyer-Villiger oxidation and esterification. The study on the influence of the following parameters on the reaction rate and selectivity will include: the effect of the concentration of the reactants, structure and amount of catalyst, recycle of catalyst, speed of mixing, effect of solvent.

The significance of clean energy storage and conversion devices like fuel cells is continually increasing. Due to specific properties, N-doped carbons have been recently studied as metal-free electrode materials for electrochemical applications, while doped with metals have emerged as novel catalysts for various organic transformations. The search of strategies (both precursors as well as methods) to systematically tune individual physicochemical characteristics of N-doped carbons is fundamental to enable their rational design for targeted applications. The project will expand the current knowledge in this research field, concerning investigation of novel class of materials for N-doped carbons and their structure-performance relationship. The pursuit for new non-toxic, environmentally benign and safe to handle catalysts is an important goal of this project.