Technological progress is often inspired by mimicking solutions evolved from nature. Innovators, observe nature and adapt its elements in their works in a number of diverse and distant fields of knowledge, including architecture, medicine, mechatronics and IT systems. In the area of chemical engineering, one of the goals is to develop an ideal multifunctional chemical reactor, reassembling organic cell, built of specialized, integrated elements in which processes occur sequentially. A synthetic equivalent of this sequential transformation is the tandem strategy in which the products of the first reaction step are substrates of the next one. The essential advantage is the lack of addition/separation of intermediates between successive stages. The use of this synthesis method reduces the consumption of substrates and the number of wastes. The complexity of the tandem process imposes the presence of different centres, often with antagonistic properties. The challenge is to design the catalytic system which provide both the appropriate concentration of active centres with different functions and their cooperative interaction.

The aim of the project is to combine the advantages of micro-flow technology and multifunctional catalysis to develop an innovative reaction system for comprehensive synthesis of chemical compounds based on tandem catalysis assumptions. The reactions will be carried out in continuous-flow microreactors, with active cores based on monoliths with a hierarchical structure of pores. They are characterised by the presence of a channels' system, formed by interconnected macropores, which enable transport of media to the extended internal network of micro/mesopores and a large specific surface area, of the several hundred m^2/g. To obtain bifunctional catalysts, monoliths will be modified with precursors of acid or/and base properties. Sequences composed of suitably combined reactions (deacetylation, hydrolysis, Meerwein-Ponndorf-Verley and Knoevenagel condensation) will allow to produce compounds such as lactones or quinazoline in an integrated "one-pot" process. It is anticipated that planned optimization of process conditions make the transformations more selective and efficient.

The project objective is in line with an intensively developing research stream on continuous chemical processes, for pharmaceutical, food and cosmetics industries.