Description for the general public (in English)

Continuous progress of life sciences is the main driving force for new developments in food, pharmaceutical and agricultural industries as well as enhancements of health and quality of life. While the conceptual science is well developed and continually evolves rapidly, urgent changes are necessary if Europe is to turn this scientific capacity into competitive and marketable products which improve the quality of life, reinforce the competitiveness of industry and protect the environment. It is no longer a secret that the gap between human activities and the capacity of the natural resources upon which they depend is steadily widening. Environmental degradation is feeding back into new global problems for society while the worlds papulation, food and health-care costs continually moves upwards. In this context, chemistry was and remains one from the main reasons for the current state of progress and fortunately it is the main operating tool on our hands to solve current and future problems.

Particularly, among the frontier challenges facing synthetic organic chemistry in our century are the interconnected goals of increasing control of chemical reactivity and selectivity along with synthesizing complex target molecules with higher levels of efficiency. The natural resources such as oil, natural gas etc, provide the backbone of main consumer products; however, the transformation of natural resources to the target substances applying traditional approaches of synthetic chemistry often involves numerous steps, produces large amounts of waste and is expensive. In this regard, the ideal synthesis of target organic molecules from naturally available substances would be the direct transformations of carbon-hydrogen (C-H) bonds to corresponding functional groups. Noteworthy, C-H bonds are ubiquitous in naturally available substances, although most of them usually are inert and not prone to participate in the chemical reactions. Nevertheless, *via* invention of processes in which C-H bonds in hydrocarbons can be activated is allowing chemists to exploit organic compounds in previously unimaginable ways. The term "C-H activation" means treating a C-H bond in some way that would allow a reagent to smoothly react with the carbon atom of C-H bond. Particularly, this process can be successfully accomplished by using various complexes of transition metals in catalytic quantities.

The transition-metal-catalyzed C-H activation reactions could revolutionize the chemical industry in the nearest future. Going into details it should be noted that for example readily available natural resources such as fuels, which are vast, low-cost feedstock of hydrocarbons, remain untapped as a raw material, simply because there has been no easy way of turning it into synthetically useful compounds. In this regard the transition-metal-catalyzed C-H activation allows chemical groups to be placed directly in a molecule where none existed before, a process that previously often needed several steps and usage of not selective, environmentally unfriendly and aggressive reagents. The transition-metal-catalyzed C-H activation is especially useful for shortening multi-step syntheses, which are commonly used in drug discovery.

Once the "activation" of single C-H bonds in hydrocarbons becomes possible, another problem may arise; in particular, usually the distinction between reactivity of various C-H bonds in hydrocarbons is negligible, hence targeting a specific C-H bond may be problematic. In this respect, there are two different strategies to solve the task of selectivity. In some cases, there is, in principle, a natural distinction in reactivity between C-H bonds based on steric and/or electronic effects of corresponding hydrocarbon, which may direct the C-H functionalization to specific position. The transition-metal-catalyzed direct and selective C-H functionalization of hydrocarbons, where the selectivity is caused by the different distribution of the electron density and/or steric effects, is well-known as "*innate*" C-H activation. In contrast to "*innate*" C-H activation, it seems clear that the C-H functionalization of the other positions of the same molecules have to be "*guided*" in order to get at least moderate levels of selectivity, because usually these positions are not accessible due to electronic and/or steric factors. The most extended strategy to achieve a "*guided*" C-H functionalization lies on the use of functional groups bearing atoms with free lone pairs of electrons, that is, atoms capable for the coordination to the catalyst.

Our recent studies revealed that the nitro group can be applied as a new highly efficient directing group for transition-metal-catalyzed "*guided*" C-H functionalization of readily available and cheap arenes. In the frames of current research proposal we are going to extend the scope of our strategy towards various carbon-carbon and carbon-heteroatom bond forming reactions using selected nitro group directed transition-metal-catalyzed C-H activation reactions. The products to be obtained, namely the *ortho*- functionalized nitro arenes are unique precursors with broad application scope and possibilities for the subsequent functionalization. Many of chemical compounds of this type are semi-products in total synthesis or synthesis of marketed drugs and are hardly accessible using conventional synthetic methodologies. Further we are aiming to use these transformations for the engineering new highly efficient and low-cost procedures towards the synthesis of various valuable heterocycles and some best-selling commercial drugs (such as Aripiprazole, Valsartan, Irbesartan, Quetiapine, Olanzapine, Diclofenac etc).