Title of the project: New pathways for functionalization of phosphorus-rich ligands.

Phosphorus has special position in periodic table because it links the living and non-living worlds. This element plays an important role both in biological cycles - e.g. RNA-DNA and inorganic cycles which are involved with using of fertilizers. Phosphorus displays relationships with its neighboring elements (e.g. linear with nitrogen) and diagonal relationship with carbon. These features show great and still undiscovered potential of phosphorus in many modern topics of basic and applied research. Because of the unique role of phosphorus, chemistry of this element is very attractive for applications in innovative areas. New phosphorus compounds are successfully used in molecular sciences, such as materials and polymer sciences, nanotechnology, catalysis, and life sciences including medicinal applications. Two Nobel prizes in chemistry in the twenty first century for enantioselective catalysis (Noyori, Sharpless and Knowles - 2001) and for application of carbene complexes of transition metals in metathesis reactions (Grubbs, Schrock and Chauvin - 2005) confirmed key role of phosphorus chemistry in catalysis. In both cases designing and synthesis of phosphorus-based ligands with desirable properties were crucial.

In this project we propose new methods for functionalization of phosphorus-rich ligands. Our preliminary experiments stated that phosphanylphosphinidene group (R_2P-P) is a useful building block for synthesis of new di- and polyphosphorus ligands. These results showed great synthetic potential of R_2P-P group and encouraged us for further studies on reactivity of phosphanylphosphinidene complexes of transition metals. As a starting compound for these studies we selected complex of platinum [(η^2-*t*Bu_2P=P)Pt(P*p*-Tol_3)$_2$], because it can easily be obtained in high yield and - what is unusual for low-valent phosphorus compounds - it is relatively air stable. Moreover properties of platinum metal center (e.g. low oxophilicity) differ significantly from other systems containing R-P or R_2P-P ligands.

We expect that platinum phosphanylphosphinidene complex [(η^2-*t*Bu_2P=P)Pt(P*p*-Tol_3)$_2$] will react with compounds containing C-X, P-X and B-X bonds (X = Cl, Br, I) with formation of new carbon-phoshorus, phoshorus-phosphorus and phosphorus-boron bonds. Furthermore, we plan to study reactivity of R_2P-P group towards simple inorganic molecules such as S_8 and Se_8 and oxidizing agents which can provide new phosphorus ligands with P-E (E= O, S, Se) functions. Subsequently, reactions of phosphanylphosphinidene group with boron compound R'$_3$B or R'$_2$BCl can constitute a new access to ambiphilic phosphine-borane ligands.