The main objective of this project is to enhance bonding strength at matrix-reinforcement interface in order to obtain increased tribomechanical properties of metal matrix composite.

Resulting properties of composite are not a simple sum of matrix and reinforcement properties. One of the basic phenomenon that should be taken into consideration is interface strength of matrix and reinforcement. To imagine interfacial behavior, one can assume 2 extreme examples. First, if interfacial strength is equal to 0, than reinforcement particles can just fall out of the matrix and for example tensile strength decreases, similarly to the situation where incised sample is weaker than sample without this defect. Second, in case of very strong interface, tensile strength would be similar to tensile strength of material of the matrix. This simple example shows that increasing interfacial strength would directly influence properties of the composite, namely mechanical and tribological properties. Hard, ceramic particles are often used as reinforcement, for instance silicon carbide SiC or aluminium oxide Al_2O_3. When the bonding strength of particle and matrix is weak, then during relative movement in friction pair particles are easily torn out of matrix. Due to the fact that particles are hard, they can be spike in the counterprobe and plow and micro-cut the surface of sample, significantly increasing friction and wear. On the other hand, for very high interfacial strength, particles will stay bonded to the matrix and it will decrease wear and friction. In the project, method for direct interfacial strength measurement is proposed as well as a technological method leading to increase of bonding strength. Alsos, tribological tests will be conducted in order to establish how bonding strength influences friction and wear behavior. Additionally, micro-friction between particle and matrix will be measured by means of Atomic Force Microscope (AFM). It will help in modeling and simulating phenomena occuring during cracking in uniaxial cyclic load tensile tests. AFM is typical device used for such purposes however in this approach we need to measure friction in nickel-SiC tribo-pair. In order to solve this issue, we will use our novel method of fabrication of metal AFM probes, which allows us to produce nickel cantilever. AFM will be also used for direct measurement of bonding strength. Reinforcement particle will be glued to tipless cantilever. Then cantiliver will approach to the substrate surface. On this Surface electrolyte will be applied so electrodeposition of nickel can be conducted. Glued particle will be embedded in deposited nickel layer, then AFM will pull-out the particle from nickel deposit and force will be measured. Maximum force needed to pull-out will be a measure of bonding strength. The higher the force, the stronger the interface. What is more, during electrodeposition particles are subjected to oxidation. Therefore in fact we have interface between oxide layer and matrix. Probably it has negative influence on bonding strength. In order to avoid such phenomenon we proposed a method of protection. Prior to electrodepoistion, particles will be coated with protective layer. We will use PVD technique and electroless deposition on reinforcement particles. Optimal parameters for these processes will be established in terms of highest resulting bonding strength.

To conclude, the main objective of this project is to enhance bonding strength at matrix-reinforcement interface in order to obtain increased tribomechanical properties of metal matrix composite. The main method of this project is a quantitative mechanical investigation of an interface in metal matrix composites with ceramic reinforcement.