The aim of my project is to examine the relationship between the state of the pulsed plasma of glow discharge, generated with the involvement of the magnetic field energy in a under the conditions of changeable concentration of plasma formative gas molecules and the state of interfacial region of the substrate and coating deposited during this process which is a result of condensation of plasma components at the surface of the substrate. This method of plasma generation is novel among the methods of synthesis of coating materials. In recent years, pulsed methods using relatively high power density in order to generate highly ionized plasma took an eye of researchers from the field of plasma surface engineering discipline. It was noticed that the coating materials synthesized by these techniques are characterized by unique properties. Studies carried out at the Faculty of Materials Science and Engineering at Warsaw University of Technology, concerning coatings synthesized in an environment of plasma generated in conditions of dynamically changing concentration of gas molecules, led to similar conclusions, and it should be noted these research concerned standard methods of electrical generation of plasma. The results of our research in this area have suggested that despite the use of standard plasma source, the plasma is generated under pulsed controlled concentration of gas molecules characterized by higher energy of its components. It transpired that the factor responsible for this effect is reducing the kinetic energy dissipation of plasma particles on elastic intermolecular collisions with neutral gas molecules. Plasmoids (discrete packs of plasma) generated in the pulse mode of gas concentration, are spread out under conditions which promote the preservation of the energy transmitted to the plasma state from the electric field driven by power source.

I believe that there is a strong relationship between the plasma generation under conditions of a pulse changeable gas concentration, the plasma state and thereby its impact on the substrate surface, which result is the formation of the characteristic structural state of interfacial coating-substrate region. Demonstration of this relation should provide an explanation of the good functional properties of coatings synthesized in that way. The functional properties of materials always derive from their structure, phase and chemical state and this depend from techniques of synthesis. It must be emphasized that this novel method of materials synthesis stays in the same footing with the current trend of development of this group of methods, since it also concerns the use of plasma state characterized by a higher kinetic energy of its components. The element of novelty in this case is not using the high-power plasma source generating plasma with high degree of ionization, but the attempt to preserve the kinetic energy of the plasma particle during propagation in the ambient. This issue is still unrecognized and may lead to results which are relevant for the knowledge about elementary phenomena in non-equilibrium processes.

In order to verify the project assumptions I plan to characterize the elementary phenomena and the effects of energy exchange between the state of the plasma and the surface of the substrate material. This objective research must be carried out using advanced high-resolution experimental methods, sensitive for characterization of subtle interactions occurring at the interface of substrate and coatings material. I am going to use the method of Secondary Ions Mass Spectrometry SIMS to determine the chemical state in the interface. Phase state will be defined by using advanced methods of electron microscopy: High Resolution Transmission Electron Microscopy HRTEM, Scanning Transmission Electron Microscopy STEM and energy dispersive X-ray spectrometry EDX.