The research project concerns the phenomenon of friction, which is one of the most common and affecting us physical phenomena. **Friction accompanies many technical and biological processes**, from moving to the operation of complex machinery, in which it often causes significant energy losses and material wear. For these reasons, the basic knowledge of friction is in the field of interest not only of physicists and engineers, but also chemists, biologists and specialists in many other fields of science and types of human activity.

Although **tribology** (Gr. *tribo* – friction, *logia* – knowledge of) as the science of interacting surfaces in relative motion is a well-established research area, still many important questions have to be answered. One of them regards the dependence of friction on the sliding velocity of interacting bodies. According to Coulomb's law of friction, the kinetic friction is independent on the sliding velocity. However, modern research, both experimental and theoretical, indicates a significant, though diverse, dependence. This is due to the complexity of the friction phenomenon.

One of the common, modern friction models identifies **three major sources of friction: deformation of the contacting asperities during relative motion, so-called stick-slip effect, and interfacial adhesion between contacting surfaces**. All the friction contributions depend in a different way on the sliding velocity or are treated as independent. For instance, the friction force in the stick-slip effect and the plastic deformation has been found to increase with the sliding velocity. The first of the effects is described by the **Prandtl-Tomlinson model**. In the case of wet friction (involving a layer of water or other liquid), the dependence of the friction force on the sliding velocity (as well as on the contact pressure and viscosity of the liquid) is described by the so-called **Stribeck curve**. On the other hand, for dry adhesive friction, essentially due to van der Waals and electrostatic interactions, no dependence on the sliding velocity is predicted.

Nevertheless, our recent research indicates that the adhesion force, resulting mainly from van der Waals interactions, depends significantly on the separation rate. On the basis of these results, **we have formulated a hypothesis that the dry adhesion contribution to friction should partially reflect the dependence of the dry adhesion force on the separation rate.** We plan to conduct series of experiments on the hydrophobic surfaces of nanolayers, using a specially constructed measurement system, whose main elements will be: an atomic force microscope (AFM) working in the lateral force mode and a single-axis piezoelectric element of high work frequency with a dedicated power amplifier. The measurement system should ensure a sliding velocity of 2-3 orders of magnitude greater than achievable by a standard AFM. The experiments will be performed at the nanoscale to control strictly the interactions between surfaces and limit them to dry adhesion. The applied loads will be near zero or even negative to reduce the influence of the stick-slip effect. It will be an additional challenge, but will be possible due to the use of sensitive AFM cantilevers. In addition to experimental measurements, we plan to perform **series of simulations using non-equilibrium molecular dynamics methods** in order to obtain additional information about nanofriction, especially for the range of high sliding velocities (> 1 mm/s). **In addition to measuring the dependence of adhesive friction force on the sliding velocity and the determination of its correlation with the adhesion force, the goal of the project is to extend the current theoretical models of friction for a kinetic component of the dry adhesion contribution.**

The implementation of the project will not only allow a better understanding of the adhesion role in the phenomenon of friction but it will also influence the design of mechanical devices and materials with desired friction properties, providing theoretical tools for predicting the friction force depending on the load and mutual velocity of cooperating elements. This is particularly important at the micro- and nanometer scale, in which due to the large surface to volume ratio, adhesion and dry adhesive friction are becoming the basic phenomena determining the course of complex processes. An example is the way the gecko moves, whose motor-adhesive system, using van der Waals interactions, allows the lizard to move on smooth surfaces of walls and ceilings as well as the operation of micro- and nanoelectromechanical devices, such as acceleration microsensors installed in smartphones or airbags.