The rapid development of new technologies, leading to miniaturization of devices used in everyday life (i.e. integrated circuits or optical data transmission technology), as well as the prospects of new technologies (such as integrated circuits based on organic molecules or building memristors) causes a great interest in basic research in nanoscale. Scientific activity of applicant group covers various aspects of modern engineering materials and properties of nanoscopic material systems.

The aim of the project is to study the correlation between the type of structural and electronic defects, in the atomic-scale, on TiO_2 crystal (110) surfaces, resulting from different preparation methods, and the interface properties of molecular nanostructures grown on these surfaces in the self-assembly process. Preparation of atomically flat terraces consisting of, among others, annealing process leads to reduction of the surface (the structure of TiO_{2-x}) and formation of extended structural defects in the subsurface region. An ending of these extended defects at the crystal surface (which take the form of point or linear surface structures) leads to inhomogeneity of electronic and structural properties of the TiO_2 surface. The presence of these defects, in turn, has influence on the properties of the growing molecular structures. Most of the organic molecules used in electronic applications are based on π-conjugated electronic systems (e.g. linear molecules oligoaceny, oligofenyle and oligotiofeny consisting of aromatic rings). In the case of metal substrates, strong interaction (overlap of the π-orbitals with the electronic cloud of metallic surface) results in the horizontal alignment of the molecules (they adsorb flat on metals). On the contrary, on the dielectric surface (like metal oxides), the interaction of molecules with the substrate is weaker. The interaction between neighboring molecules may be a decisive factor determining the properties of assembling molecular layers especially in the case of not-homogeneity of the substrate surface. In the era of rapid development of molecular electronics, manufacturing in a controlled manner of the molecular layers of a semiconductor, will allow to produce molecular field effect transistors (OFET), light-emitting diodes (OLEDs) and solar cells.