Popular description

Periodic nanostructured materials create a new class of laboratory-fabricated interfaces with extraordinary optical and electronic properties, unheard of in nature or impossible to fabricate using conventional technologies. The use of diamond as the key material in such structures allows for taking advantage of its unprecedented set of properties as high chemical stability, optical transparency, electronic functionality and robust bio-interfaces and biocompatibility. However, conventional nano-structuring of diamond is extremely difficult due to its high hardness and chemical resistance. The solution seems to be bottom-up approach, synthesizing suitable functional nanostructures and patterns directly by adjusting growth conditions and by combination with other materials. Hereby, 2D structures are achievable by depositing a synthetic diamond on form-defined matrices produced by advanced methods used in the semiconductor industry. Another approach is the fabrication of three-dimensional nanostructures from diamond composites that induce periodicity.

The aim of the project is to take advantage of the latest advances in such diamond nanotechnology achieved in the PL and CZ teams and thereby design, produce, and analyse function of new hybrid 3D nano-structured diamond surfaces with view to novel opto-electro-chemical functions that will be beneficial for the current high needs of biosensors. A unique feature of the fabricated structures will be the possibility of obtaining (and controlling) simultaneous optical and electrochemical signals improving the detection of specific biological targets such viruses or their protein parts. In order to achieve selectivity and specificity for a biological target, we will bio-functionalize the structures with antibody biological receptors by a series of binding and activation processes of chemical and biological nature. Synergy of simultaneous optical and electrochemical measurement are expected to provide high sensitivity, reduction of false-positive results, and to shorten the measurement time in relation to the standard sensors. The combined opto-electro-chemical measurements will be studied with particular view to more reliable early diagnosis of viral infections.

Reaching such challenging aim will be made possible he joint action of Polish and Czech scientific teams that have unique complementary technological and scientific expertise in the area of diamond, electrochemistry, and sensors. Scientists from Prague specialize in the creation and diagnosis of periodic diamond nanostructures and microscopic analysis, researchers from Gdańsk are specialists in modifying their electrochemical parameters, while the group from Warsaw has expertise in optics and optoelectronics, mainly dealing with biosensors.