Slovak Diamond Group

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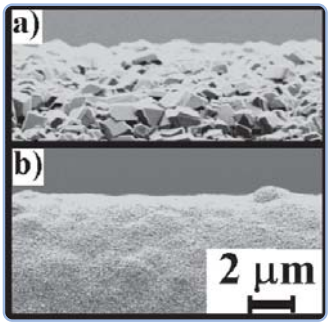
Slovak Diamond Group *is a R&D team working in Vacuum Technology and Electronics Section of the Slovak University of Technology in Bratislava, exactly at Faculty of Electrical Engineering and Information Technology, Department of Microelectronics. We are primarily interested in diamond thin films, Diamond-like Carbon (DLC), Carbon Nitride (CN_x) layers and Carbon Nanotubes (CNT). We are able to perform (selective) CVD growth of homogenous polycrystalline and nanocrystalline diamond and above mentioned thin films for large range of mechanical, electrical, optical and particular biological applications.*

Micro- and Nano-crystalline Diamond Thin Films for Mechanical Applications.

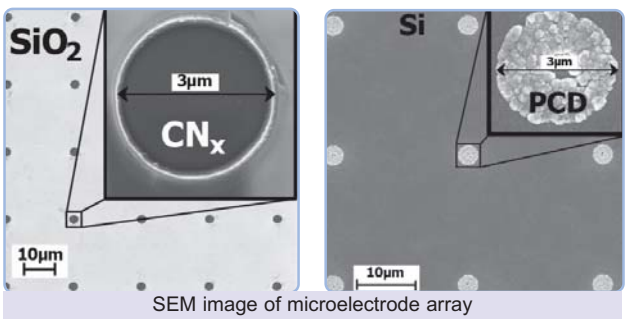


PCD and NCD films on WC-Co cutting tool

We have used Hot Filament CVD technology with Double Bias Enhanced Nucleation developed at our Department to produce smooth and homogenous nanocrystalline (NCD) and polycrystalline (PCD) multilayer diamond thin films with low roughness and high adhesion on standard WC-Co cutting inserts. The NCD and PCD multilayer thin films were deposited layer by layer through regulating both substrate bias and methane concentration. The structure of diamond layers was ranged from high phase purity PCD to NCD containing amorphous carbon component and one layer was successfully grown over the previous one. Substrate bias voltage was demonstrated to be the tool for changing the deposited layer grain size.

Nano-crystalline Diamond Thin Films and CNx Layers for Electrical Applications.

One application in this field, which we are dealing with, is a sensor based on polycrystalline diamond (PCD) and carbon nitride (CN_x) microelectrode array (MEA) for detecting Pb^{2+}. Electrochemical stripping voltammetry method offers a simple, quick and cheap way of detecting trace metals such as (Pb, Cu, Cd, Mn, Ag) in water. The minimum measurable current response to Pb^{2+} concentration on PCD was $1x10^{-4}$ mol/l, and on CN_x $5x10^{-6}$ mol/l. We are interested also in another electrical application of CVD diamond layers such as Schottky rectifying diodes, or electrochemical sensors for pharmaceutical and automotive industry.



SEM image of microelectrode array

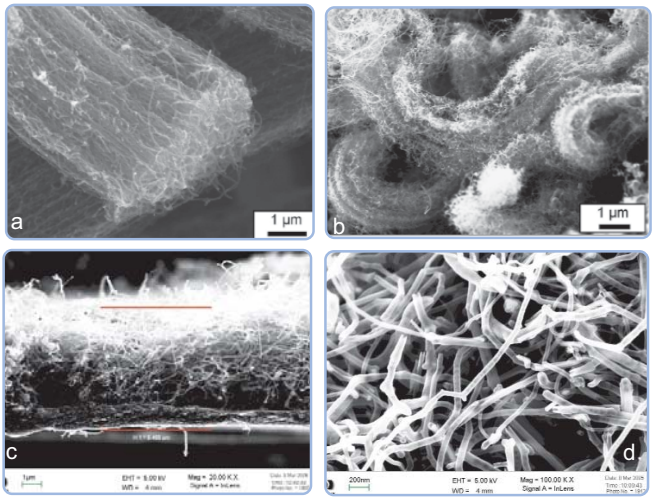
DLC and CNx Thin Films for Biological Applications.

We are producing smooth and homogenous DLC and CN_x thin films on hip replacement joints made of standard titanium alloy Ti–6Al–4V. For deposition of DLCs and CN_x we are using an UVNIPA-1-001 vacuum system with three sources (gas ion source for cleaning, electric arc source for non-magnetic metal sputtering and pulse arc carbon source for DLC deposition). Low deposition temperature opens the new window for many cheaper applications in medicine such as cover layers of hip replacement joints, nails, or cover microscopic glass for research of DNA or any biological tissue growth.

Optical image of CNx layer on hip replacement joints

Carbon Nanotubes.

Our CNTs are produced by HFCVD method on various substrates (Si, sapphire, glass, etc.) with various catalysts. Recently, we are finalizing two apparatus based on Arc-Discharge and Laser Ablation methods for CNT preparation. We have analyzed their electrical and optical properties such as emission, electrical conductance, influence of various gas concentration or behavior under different ambient condition primary for sensor applications.



(a)CNT bundles on sapphire substrate. (b) Bundles of carbon nanotubes on amorphous glass. (c) CNT array on Cu substrate. (d) CNTs on Si with Ni catalyst


Arc discharge UVNIPA-1-001 sputtering system

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