

## Abstract

Understanding and control of interactions between biological environment (cells, proteins, tissues, membranes, electrolytes, etc.) and solid-state surfaces is fundamental for biomedical applications such as bio-sensors, bio-electronics, tissue engineering and implant materials as well as for environmental monitoring, security and other fields. Diamond can provide unique combination of semiconducting, chemical, optical, biocompatible and other properties for this purpose.

In this thesis we characterize electronic properties of protein-diamond interface by employing a solution-gated field-effect transistor (SGFET) based on hydrogen-terminated diamond, surface of which is exposed to biological media. We elucidate the role of adsorbed protein layer on the electronic response of the diamond transistor. We investigate effects of cells (using mainly osteoblast cells as model) on diamond SGFETs transfer characteristics and gate currents. We employ nanocrystalline diamond (NCD) thin films of different grain sizes (80 - 250 nm) to characterize and discuss influence of grain boundaries and sp<sup>2</sup> phase on bio-electronic function of SGFETs. We investigate effects of gamma irradiation on function and stability of hydrogen-terminated diamond SGFETs interfaced with proteins and cells, showing feasibility of real-time monitoring of radiation treatments. We developed and tested portable battery-driven device. We also show a way for recycling used diamond SGFET devices. The results may thus contribute to better understanding and novel applications of diamond SGFETs in biosensors and other fields.