Diamond-based nanophotonics: development of a biosensing platform.

Significant scientific breakthroughs are expected in the area of emerging nanophotonic materials. These include wide bandgap semiconductors with high piezoelectric activity and high non-linear response (GaP, GaN, AlN...) or diamond material that exhibits a high Young's modulus, chemical stability, high thermal conductivity as well as biocompatibility, to name a few. Such unique properties have been scarcely exploited until now in the context of nanophotonics though promising. They may pave the way towards various material-enhanced applications in non-linear optics on a single chip-setting, in the engineering of label-free miniutarized biosensors with high sensitivity (protein or virus detection, drug tracing, investigation of protein-protein interaction...) as well as in the engineering of on-chip acousto-optical devices in strong connection with nano-optomechanics.

Focusing on diamond, one breakthrough can rely on the combination of the high sensitivity provided by high-Q photonic crystal resonators and the advanced bio-functionalization allowed by the chemical versatility of the diamond surface. This can lead to a disruptive technology of diamond-based optical resonator biosensors. This is one the objectives of the CONDOR project, funded by NanoSaclay Labex, which gathered four laboratories of the Saclay area, notably the "Institut d'Electronique Fondamentale" (CNRS/Univ PSud) and the Diamond Sensors Laboratory (CEA LIST) for diamond-photonics aspects that have a strong recognized expertise in photonics as well as in diamond growth, processing and functionalization. In this project, we aim at developing biosensors able in real-time to detect very small quantities of biomolecules as well as to measure the thickness and conformation changes in the absorbed proteins.

The post-doctoral activities will cover the development of the diamond material (synthesis by CVD assisted by micro-wave plasma, smoothing by RIE, material characterization by HR-SEM, AFM, etc.), the modelling and the realization of the photonic platforms in the IEF clean room facilities, as well as the experimental characterization and the biofunctionalization of the biosensor.

References :

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