NEW GENERATION LABEL-FREE OPTICAL BIOSENSORS BASED ON SILICON NANOWIRES

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The realization of a new category of low cost label-free sensors providing strong reliability, high sensitivity, easy handling with a simple and fast response for self-use and domestic healthcare has been of great interest for the whole research community. We develop an innovative low cost and industrially compatible method based on metal assisted chemical etching to realize an ultradense array of luminescent at room temperature Si NWs. NW obtained by this approach exhibited a very bright room temperature photoluminescence (PL) visible by naked eye and tunable with NW size in agreement with the occurrence of quantum confinement effects. An innovative optical biosensor based on these silicon nanowires is realized, which exploits the PL properties for the selective detection of proteins in a wide range of concentrations, down to the femtomolar limit in serum. By changing the functionalization protocol we realized a DNA sensor capable to reveal few copies of pathogen genome with very strong selectivity. Moreover, the flexibility of this sensor was demonstrated by another application. The contribution of small Extracellular Vesicles (sEVs) in human pathology has been widely demonstrated, and sEVs are recently emerging as strategic biomarkers of cancer, neurodegenerative, cardiovascular diseases, and as potential and important targets for therapeutic intervention. However, their use for real medical application is still limited due to the selectivity and sensitivity limits of the commonly applied approaches. We report the realization of a selective sensor based on Si NWs able to isolate, concentrate quantify and analyze sEVs CD81+, from minimal volumes of biofluid and its promising application in early diagnosis, monitoring disease progression and treatment efficacy in ovarian cancer. Si NW optical biosensors present a fast time of analysis, a broad flexibility of detection over a wide concentration range, a high selectivity opening the route toward a new generation of label-free optical biosensors.