Gold coated silicon nanowires for near-infrared thermal treatment of cancer cells and in-situ Raman monitoring of the process evolution

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The use of nanotechnology in cancer therapy promises the development of novel approaches or the improvement of the existing ones with minimal invasive treatments able to eliminate selectively the cancer cells without damaging the healthy tissues. In this perspective, photothermal therapy (PTT) assisted by nanomaterials has recently emerged as a very promising strategy to overcome the intrinsic limitations of the conventional surgery because of unique advantages including high specificity, minimal invasiveness and precise spatio-temporal selectivity [1, 2].
In this work we report on the capacity of highly disordered and randomly oriented gold covered silicon nanowire (Au/Si NW) array to induce the photothermal death of cancer cells and monitor in situ the evolution of the treatment. We fabricated 2-3 μm long SiNWs by Plasma Enhanced Chemical Vapor Deposition (PECVD) and covered with an evaporated Au layer, 150 nm thick. A monolayer of human colon adenocarcinoma cells (CaCo-2), a popular cancer in vitro model [3] commonly employed for biopharmaceutical evaluations, was directly grown to confluence onto the Au/SiNWs and then irradiated by infrared laser at 780 nm. We found the laser irradiation to efficiently induce the death of several tens of CaCo-2 cells within a localized area and allow simultaneously the recording of Raman spectra from the irradiated zone following the evolution of the treated cells.
Furthermore the proposed material is also characterized by very attractive features such as *i.* the enhanced NIR absorption in a large range overlapping the I, II, and III biological windows; *ii.* the ease and scalable fabrication methodology compatible with polymeric or glasses supports which provide an effective method to integrate the Au/Si NWs in optical fiber laser devices [4,5]; the cell friendly behavior. These remarkable properties make the Au/SiNWs suitable to be integrated in optical fiber laser devices for endoscopic therapies with intraoperative monitoring and as platform to develop novel photothermal treatments by using different cancer cell lines and NIR laser source

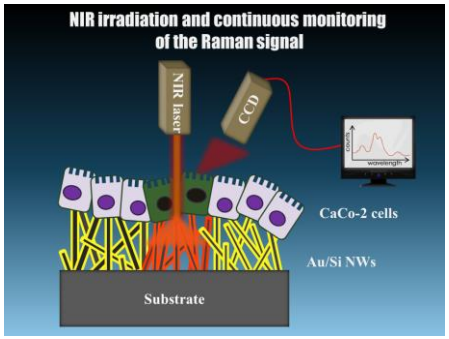

Figure 1.Schematic representation showing NIR irradiation of a monolayer of CaCo-2 cells grown on Au/SiNWs and continuous Raman signal monitoring.

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