Title: Biosensors based on the innovative optical properties of silicon nanowires

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Silicon nanowires (NWs) are considered promising building blocks for a wide range of future nanoscaled devices due to their superior properties. The cheap, fast, maskless and Si technology compatible synthesis of 2D random fractal arrays of vertically aligned Si NWs by metal assisted chemical etching is of great impact for the management of light-matter interaction. We demonstrated the control over the optical properties of the system through the optimization of NW spatial arrangement with different fractal geometries[1]. Strong in-plane multiple scattering and efficient light trapping related to the fractal structure were observed[2]. NWs achieved by this technique exhibited a very bright room temperature photo- and electroluminescence, tunable with NW size in agreement with the occurrence of quantum confinement effect. An innovative label free optical Si NW biosensor was realized by exploiting the PL quenching upon the selective capture of target proteins or genome. A low cost selective sensor for the C-reactive protein (CRP), which is the major biomarker for heart-failure pathology, has been realized showing a high sensitivity with LoD of a few fM across a broad concentration dynamic range for non-invasive analysis in saliva. By changing the functionalization protocol, we realized a label- and PCR-free NW optical sensor capable to reveal few copies of Hepatitis B virus without amplification with strong selectivity, demonstrating the potential of Si NWs optical sensors for primary health care diagnosis.

1. ***Light: Science & Applications*** *5*, e16062, 2016
2. ***Nature Photonics*** *11*, 170-176, 2017
3. ***ACS Photonics*** *5*, 471–479, 2018