Optical nanotweezers for single cell deformability measurements

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It is now well recognized that mechanical phenotype of biological cells are related to their physio-pathological state. For example, variation of Red Blood Cells (RBCs) deformability is associated with malaria [1] and increase deformability of metastatic cancer cells [2] have been observed. Hence, a better understanding of cell deformability may imply enormous developments in disease diagnostics, therapeutics and drug screening assays. For this purpose, we propose to implement a new bio-photonic approach applied to the characterization of cell deformability. Its originality relies on the all-optical reading of cell deformability using the resonant mode of photonic crystal (PhC) micro-cavities [3]. It has been demonstrated that the presence of an object on top of a PhC micro-cavity induces a local change of refractive index associated with a spectral shift of the resonance spectrum [4]. We propose to extend this concept to the measurement of cell deformability in order to get the mechanical signature of RBCs. In this work, we demonstrate the proof of principle of our approach by the detection of RBCs deformability using a PhC micro-cavity. Moreover, we have shown for the first time that the spectral response changes of the PhC could allow discriminating between healthy and artificially mechanically impaired RBCs. This work has been funded by the French National Research Agency (ANR) under the project CELLDance (ANR-21-CE09-0011).

References

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Figures

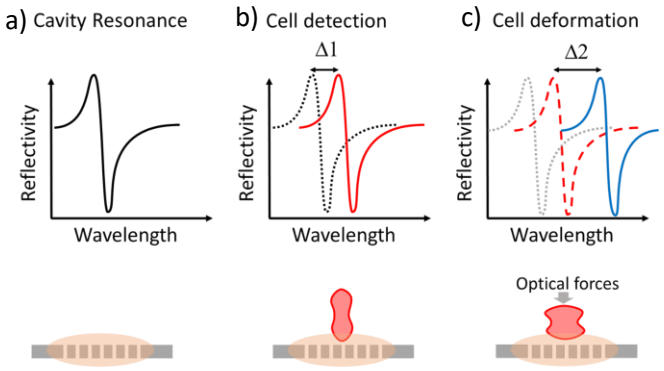

Figure 1: Schematic view of the optical response of a) an empty PhC cavity b) a cavity in presence of a RBC and c) a cavity in presence of a RBC deformed by applied optical forces.