StretchBIO - Photonic nanosystem for continuous two-dimensional Stretch monitoring of fresh tissue Biopsies

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Tissues biopsies are widely used in diagnosis and monitoring of diseases. However, they are often difficult to obtain and require surgery. In this EU project we aim to enable easily obtainable microscale biopsies to be analyzed for mechanical deficiencies. It has been established that tissue mechanics play a major role during tissue development, normal function, and diseased conditions [1]. Normal tissue elasticity is essential to support physiological tissue functions. On the contrary, numerous diseases proceed with a chronic loss of tissue elasticity inducing a progressive impairment of physiological functions [2]. A good example is lung cancer solid tumors, which present remarkable stiffness. Recent in vitro and in vivo studies [3] have reported several links between tissue stiffening, tumor progression and reduced drug delivery. There is, thus, an urgent need to early identification of tissue stiffness and apply therapeutic approaches that can rescue normal tissue elasticity. In this work a novel approach of developing a compact photonic nanosystem for measuring the in-plane forces applied to the microbiopsies will be presented. Our approach is based on a two-dimensional force sensor nanosystem with the ultimately aim of continuous ex-vivo monitoring of mechanical effects of drugs on living tissues for its use in personalized cancer therapeutics. The basic principle of the nanosystem is shown in Figure 1. It is formed by a photonic crystal, consisting of a complex nanopillar array (Figure 1a), in which one or more nanopillars are laterally deflected (Figure 1b) by in-plane forces exerted by the living tissue on the tips of the nanopillars. During the presentation, the whole nanosystem will be presented, pointing out its innovative properties and describing the actual development state of its different components.

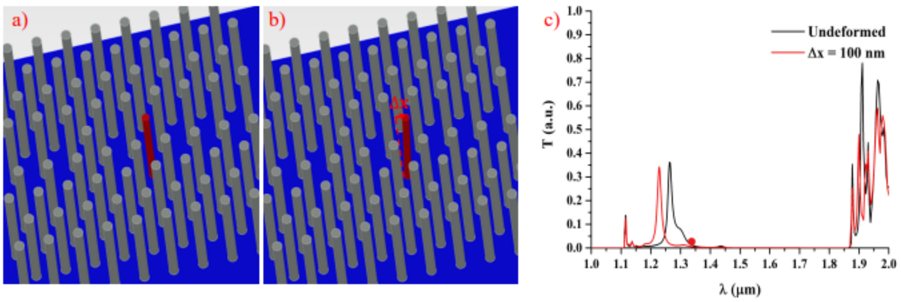

Figure 1: The nanosystem sensing approach: a) one undeflected narrower nanopillar (red) in a nanopillar matrix (grey); b) deflection of the red nanopillar upon exertion of an in-plane force; c) simulation of light transmission through the structure of undeflected (black) and deflected (red) nanopillars of figures a) and b), showing a clear shift in the resonance peak at λ=1.28 µm.

[1] C.C. DuFort et al, Nature Rev. Mol. Cell Biol. 12 (2011) 308-.
[2] F. Broders-Bondon et al., J. Cell Biol. 217 (2018) 1571-.
[3] R.K. Jain et al, Ann. Rev. Biomed. Eng. 16 (2014) 321-.
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