Title: Advanced Diagnosis at single cell level by Coherent Imaging in Lab on Chip Platforms

Abstract: Tomography is one of the most powerful imaging tools for analyzing biological samples, able to furnish complete mapping of the object in 3D. In particular, tomographic phase microscopy (TPM) [1] exploits quantitative phase imaging (QPI) techniques to map the 3D refractive index (RI) of cells, by adopting laser beam deflection, direct mechanical rotation or holographic optical tweezers (HOTs) to probe the sample along a number of controlled directions. In general, all TPM set-ups require the sample to be observed along different directions with respect to the probing beam. To date, all tomographic methods require a high-precision, opto-mechanical and/or opto-electronic device to acquire a set of many images by probing the sample along a large number of controlled directions [2,3 Here we report on a smart solution to obtain TPM of samples at lab-on-chip scale, by exploiting their tumbling inside microfluidic channels. This method, recently developed [4], presents the following advantages: (i) Permits to observe full 360° of rotating cells, this avoiding the limitation in the accuracy of tomograms; (ii) no mechanical contact neither holographic optical tweezers are needed to rotate the sample; (iii) it is suitable for application in flowing conditions with high-throughput performances. This would allow real microfluidic biomedical applications on a large scale. The results shown in [4] for RBCs and diatoms are here extended to quasi-spherical cells, by exploiting a new algorithm for rolling angle recovery in TPM [5]. In particular, we performed the 3D imaging of human breast adenocarcinoma MCF-7 cells, opening the way for the full characterization of circulating tumor cells (CTCs) in the new paradigm of liquid biopsy.

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