Integration of optical nanoscopy and quantitative phase microscopy for extracting 3D morphological information of liver sinusoidal endothelial cells
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Abstract:
Here, we report an imaging system that combines photonic-chip based single molecule localization microscopy (based on the dSTORM principles) and quantitative phase microscopy (QPM) [1]. The proposed set-up provides both qualitative, as well as quantitative information of the specimen. In chip based nanoscopy system, integrated photonic waveguides are used for excitation through their inherent evanescent field, rather than using a free space excitation source. The generated evanescent field is ideal for total internal reflection fluorescence microscopy (TIRF)-dSTORM [2]. The fluorescence signal is collected by an upright microscope, which is converted into a Linnik-type interferometer [3] to extracting quantitative phase information of the sample. The proposed set-up is used to image primary liver cell from mouse, liver sinusoidal endothelial cells (LSECs). LSECs a unique membrane morphology: regions of nano-scale holes (fenestrations) grouped in sieve plates and supported by the underlying actin network. The proposed system, when operated under optical nanoscopy mode, provide super resolution imaging of the fenestration present on cell membrane and immediately by operating the microscope in QPM mode we could extract the optical path length of the fenestrated areas. The quantitative information from QPM contains the local information about the refractive index and the thickness of the fenestration area. By performing correlative imaging, we documented both the size (using nanoscopy) and the thickness of the fenestrated areas (using QPM).

Figure: Quantitative phase map (a) and dSTORM image (b) of mouse liver sinusoidal endothelial cells. Bar represents the phase value in radian.

References: