SPATIAL LIGHT MODULATOR BASED ON THERMO-OPTICS EFFECT APPLIED TO QUANTITATIVE PHASE IMAGING OF NANO-OBJECTS

Hadrien Robert, Marek Piliarik

Institute of Photonics and Electronics,

Czech Academy of Sciences, Chaberská 1054/57,

18251 Prague, Czech Republic.

E-mail: robert@ufe.cz, piliarik@ufe.cz

Keywords: Spatial light modulator, thermo-optics effect, interferometric microscopy, quantitative phase imaging, microtubules.

Thermo-optic effect in imaging system is often associated as side effects generating aberrations. Indeed, heat can induce mechanical drift or lens dilation, and macroscopic heating is intrinsically slow. However, on microscopic scale, the heat temporal response can reach the microsecond regime and be used as an efficient thermo-optic modulator [1-2].

We developed a novel spatial light modulator based on thermo-optics effect induced by gold nanoparticles, which outperforms the state-of-the-art in numerous aspects. In comparison to the most commonly used liquid-crystal spatial light modulators, our system features no grating effect, is polarization insensitive, have high transmission rate (>80%) and could theoretically reach the sub µs response time range. Using an interferometric microscope, we could measure a π phase-shift (at λ=488 nm) and a response time as short as 70 µs (Figure 1). This allowed us to perform quantitative phase imaging of nano-object to image 3D profile of crossing microtubules (Figure 2) and perform 3D localization of diffusive protein on a single microtubule at kHz rate [3].

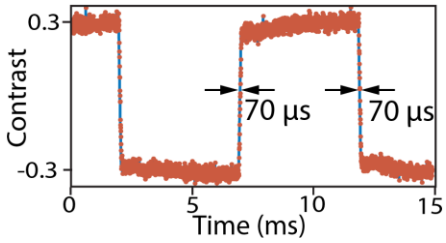

Figure 1: Response time of a phase pixel measured with an interferometric microscope.

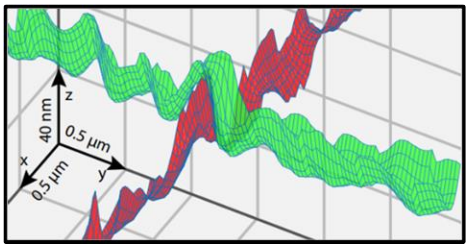

Figure 1: 3D profile of crossing microtubules obtained with quantitative phase imaging.

[1] L. Durdevic, H. M. L. Robert, B. Wattellier, S. Monneret, G. Baffou, *Sci. Rep.* **2019**, *9*, 4644.
[2] J. S. Donner, J. Morales-Dalmau, I. Alda, R. Marty, R. Quidant, *ACS Photonics* **2015**, *2*, 355.
[3]] H. Robert, Ł. Bujak, K. Holanová, M. Vala, V. Henrichs, Z. Lánský ,M. Piliarik, *Research Square*, **2020**, preprint: https://doi.org/10.21203/rs.3.rs-38429/v1.