HYPERSPECTRAL MICROSCOPE BASED ON A COMPACT AND STABLE BIREFRINGENT COMMON-PATH INTERFEROMETER

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Fourier transform (FT) spectroscopy is a powerful method for analysis in material science and life-sciences. Combining wide-field microscopy with the FT approach allows parallel and rapid recording of the spectra for all the pixels of the sample image. This approach is hindered by the need for an interferometer, which typically provides limited phase stability or requires a complex optical scheme [1]. Here we introduce a novel FT hyperspectral microscope based on a compact, highly stable common-path birefringent interferometer. We exploit the Translating-Wedge-based Identical pulses eNcoding System (TWINS), shown in Fig 1a [2]. The system relies on the interference of two delayed replicas of the detected light. By translating one of the wedges the interferogram of the light collected in each pixel of the image is formed (Fig 2a). Then, the spectrum in each pixel is reconstructed by Fourier transforming the interferograms.

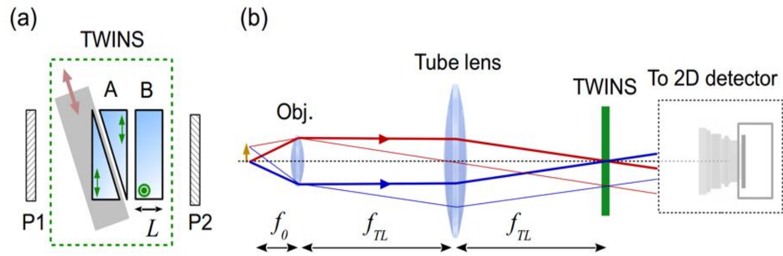

Figure 1: (a) Schematic setup of the simplified TWINS interferometer; P1, P2: polarizers at +/- 45° with respect to the horizontal plane; A-B: birefringent blocks, made of α-BBO crystal; green double arrow and green circle indicate the orientation of their optical axes; L = 2.4 mm. (b)

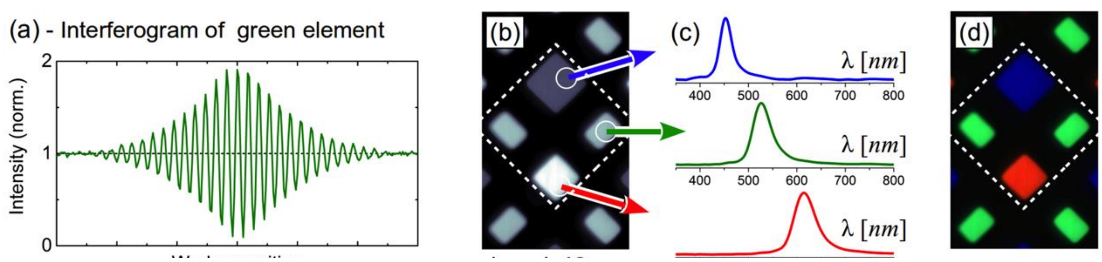

Figure 2: (a) Interferogram of a pixel on a green-emitting element of the RGB screen; (b) B/W image of one pixel of the display. (c) Spectra of three points of the image, after FT of the corresponding interferograms. (d) Synthesized RGB picture from the spectral information of each pixel.

To characterize the spectral accuracy, the resolution, and sensitivity of the microscope at different magnifications we imaged an RGB smartphone screen (Fig 2). Applications of the TWINS-based hyperspectral microscope for imaging cells and biological tissues will then be presented and discussed.

[1] D.N. Wadduwage et al., "Near-common-path interferometer for imaging Fourier-transform spectroscopy in wide-field microscopy." Optica 4.5 (2017): 546-556.

[2] A. Oriana et al., “Scanning Fourier transform spectrometer in the visible range based on birefringent wedges”. Journal of the Optical Society of America A 33, 1415 (2016)