Polarisation multiphoton multifocal microscopy

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Abstract: We show that a diffraction-limited multifocal array that possesses an identical polarisation state in each focal spot can be generated for multiphoton multifocal microscopy.
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1. Introduction

Conventionally, a multifocal array can be generated by using static optical elements such as micro-lens arrays or spinning discs. However, the intensity distribution in the focal region and the individual control of the intensity of each focal spot in the array cannot be dynamically updated. Further, it is impossible to control the polarisation states of each focal spot by employing those static elements. To address these problems, we have developed a new method to generate a multifocal arrange through the dynamic phase engineering in the back aperture of a high numerical aperture objective. A distinctive advantage of this method is its diffraction-limited nature with high uniformity for each focal spot and its intensity and polarisation individually-controlling manner [1, 2]. When this new method is integrated with a scanning optical microscope, dynamic multifocal multiphoton microscopy (DMMM) can be generated. In the experimental setup a spatial light modulator (SLM) was adopted to engineer the phase and the polarisation state of an incoming beam that is focused through the objective in real time. DMMM is a powerful and important tool in biomedical optical imaging research, which enables fast image acquisition with high laser power efficiency and polarisation sensitivity.

2. References

[1] H. Lin, B. Jia, and M. Gu, *Opt. Lett.* **36**, 406-408 (2011).
[2] H. Lin, and M. Gu, submitted (2013).