APPLICATIONS OF NANOGRATINGS: FROM SINGLE-SHOT OPTICAL SECTIONING TO GENERATING THIN, LONG-FOCUSED BEAMS

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Nano-structured gratings are formed as a result of birefringent modifications in fused silica substrate upon controlled irradiated by ultrashort laser pulses [1]. Since these nanogratings are always oriented perpendicular to the laser polarization, their structural properties and birefringence can be easily manipulated for several novel applications in the field of high resolution microscopy. Here, we describe the proof-of-concept realization of two such applications: single-shot optical sectioning and creation of thin, long-focused beams

A single-shot optical sectioning technique for yielding high temporal resolution, also known as polarization-coded Structured Illumination Microscopy (\textit{picoSIM}) [2], can benefit greatly by using nanogratings. The complicated polarization-coded pattern with a uniform intensity distribution and linearly varying polarization needed for \textit{picoSIM} can be readily generated by nanogratings, thus simplifying the setup. Moreover, it also enables the use of incoherent light and extends the applications of \textit{picoSIM} to material microscopy, as demonstrated by the optically sectioned images of a ceramic chip in fig. 1 (a).

The versatility of nanograting can also be leveraged to generate thin, long-focused beams that are ideal for scanning microscopy due to their Bessel-like propagation properties. This design is based on the concept of maximally-flat filters [3]. A hybrid mask that combines a radial polarization converter and a multi-ring binary phase element is used to produce such beams (fig. 1 (b)). A prototype of this hybrid mask has been fabricated and tested.

REFERENCES:  