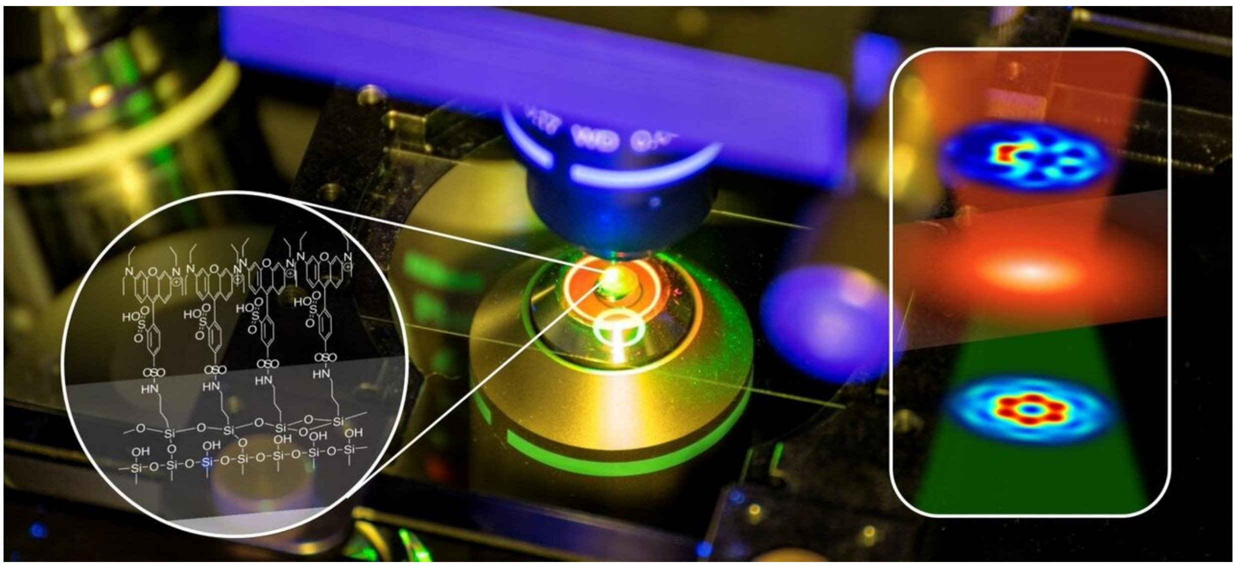
New method for the measurement of nano-structured light fields

September 20 2019



A monolayer of organic molecules is placed in the focused light field and replies to this illumination by fluorescence, embedding all information about the invisible properties. Credit: Pascal Runde

Structured laser light has already opened up various different applications: it allows for precise material machining, trapping, manipulating or defined movement of small particles or cell compartments, as well as increasing the bandwidth for next-generation intelligent computing.

If these light structures are tightly focused by a lens, like a magnifying glass used to start a fire, highly intense three-dimensional light landscapes will be shaped, facilitating a significantly enhanced resolution in named applications. These kinds of light landscapes have paved the way for such pioneering applications as Nobel prize awarded STED microscopy.

However, these nano-fields themselves could not be measured, since components are formed by tight focusing which is invisible for typical measurement techniques. Up to now, this lack of appropriate metrological methods has impeded the breakthrough of nano-structured light landscapes as a tool for material machining, optical tweezers, or high-resolution imaging.

A team around physicist Prof. Dr. Cornelia Denz of the Institute of Applied Physics and chemist Prof. Dr. Bart Jan Ravoo of the Center for Soft Nanoscience at the University of Münster (Germany) successfully developed a nano-tomographic technique which is able to detect the typically invisible properties of nano-structured fields in the focus of a lens—without requiring any complex analysis algorithms or data post-processing. For this purpose, the team combined their knowledge in the field of nano-optics and organic chemistry to realize an approach based on a monolayer of organic molecules. This monolayer is placed in the focused light field and replies to this illumination by fluorescence, embedding all information about the invisible properties.

By the detection of this response the distinct identification of the nano-field by a single, fast and straightforward camera image is enabled. "This approach finally opens the till now unexploited potential of these nano-structured light landscapes for many more applications," says Cornelia Denz, who is heading the study. The study has been published in the journal "*Nature Communications*".

More information: Eileen Otte et al, Polarization nano-tomography of tightly focused light landscapes by self-assembled monolayers, *Nature Communications* (2019). DOI: 10.1038/s41467-019-12127-3

Provided by University of Münster