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Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

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The synergy between nanotechnology, biotechnology and photonics is spawning the emerging fields of nano-biotechnology and nano-biophotonics. Photonic innovations already hurdle the diffraction barrier for imaging with nanoscopic resolutions. However, scientific hypothesis testing demands tools, not only for observing nanoscopic phenomena, but also for reaching into and manipulating nanoscale constituents in this domain. This talk is describing the new use of proprietary strongholds we are currently establishing on new means of sculpting light for bio-probing and excitation at the smallest cellular scales.

Two-photon spatio-temporal light engineering can be used to expand the microscopic imaging modalities available to assist this light-driven nano-manipulation approach. Featured in a recent issue of Nature Methods we were pioneering research in neuro-photonics and optogenetics highly useful for future biophotonics undertakings on the smallest cellular scales. This research promises a powerful approach for controlling light-gated ion channels and pumps that facilitates the probing of intact neural circuits by manipulating the activity of groups of genetically similar neurons. This makes it possible to precisely aim space-time sculpted light at single neuronal processes, neurons or groups of neurons. The underlying light-engineering is currently being scientifically refined in a strong international context to address - for the first time - arbitrary and speckle-free '4D' spatial and temporal two-photon light-sculpting.

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