NANOPARTICLE-ASSISTED STED NANOSCOPY WITH HYBRID NANOSPHERES

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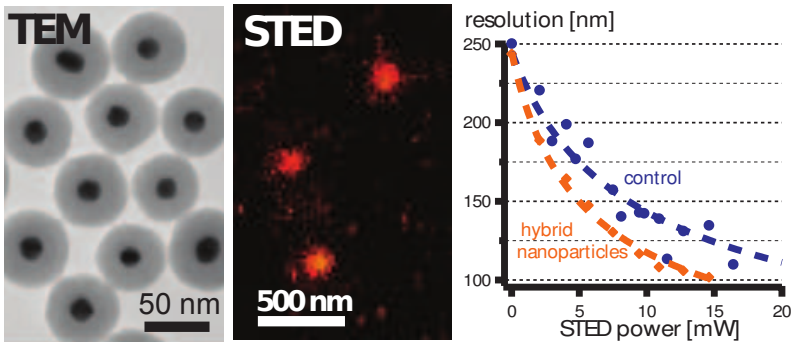
As the demand for increased optical resolution has grown in recent years, so fluorescence studies, in which light is collected from radiating molecules or nano-structures (e.g. quantum dots) have come to the fore. For example, single molecule methods such as PALM and STORM use the statistical nature of excitation and emission to build up images by selectively imaging different fluorophore subsets at different times. Further methods are those of confocal fluorescence and STED microscopy, which collect light from fluorophores within a limited spatial volume, by use of a spatial filter to limit the field of view or a doughnut beam [1] to quench the fluorescence from all but a few excited fluorophores.

Fluorescence techniques however commonly suffer from low fluorophore absorption cross-section, which in turn requires high power (pulsed) lasers or long acquisition times. Use of plasmonic effects to increase local field amplitudes has however been proposed in recent years [2] as one means of overcoming this problem. In this work we have demonstrated STED microscopy using 20 nm nanospheres composed of a gold core and coated with a fluorescently doped silica. For the first time we demonstrate sub-diffraction limited resolution achieved using hybrid nanoparticle markers. The 3.3× resolution improvement relative to standard confocal microscopy is limited only by particle size. This resolution improvement was realised using a two fold STED intensity reduction and importantly was demonstrated in an aqueous environment demonstrating the relevance and feasibility of bioimaging with hybrid nanospheres. Finally, we also show, for the first time in this context, a 3-fold reduction in the rate of photobleaching compared to standard STED, thus, enabling brighter images. Experimental results are in good agreement with theoretical calculations.



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