SUPERRESOLUTION IMAGING OF MG-63 CELL BASED ON SATURATED SCATTERING OF GOLD NANOPARTICLES

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Recently, superresolution optical microscopy has experienced rapid developments, such as STED, PLAM, STROM and SSIM *et al*, which rely on the modulated property of fluorescent emitters to break the diffraction barrier [1]. However, there are several intrinsic limitations in fluorescence-based superresolution microscopy, such as the relative high laser intensity used, low brightness and poor photostability of the fluorophores. On the other hand, plasmonic nanoparticles have provided an attractive alternative as image contrast agents due to their size and shape-tunable optical properties, strong photostability and bright signals. In 2014, S.W. Chu and co-workers have observed the scattering saturation behavior in single gold nanoparticles and utilized such nonlinear optical response to achieve superrelolution far-field imaging [2]. Where after, they described the plasmonic photoswitching effect based on the control of scattering from gold nanoparticles and demonstrated its application in superrelolution imaging to enhance optical resolution to $\lambda/5$ [3]. However, more detailed experiments to address the mechanism of plasmonic switching are required. Furthermore, optimizations of experimental conditions including the choice of particle sizes and laser wavelengths need to be performed to effectively modulate the nanoparticle scattering.

In this study, we report on the systematic investigations of nonlinear scattering suppression properties of gold nanoparticles with different sizes. And for the first time we implement the scattering-based far-field superrelotuion to bio-samples, which represents an important step forward for such technique in the real applications. By labelling the Human Osteosarcoma MG-63 Cell with gold nanoparticles, we are able to achieve sub-100 nm full width at half maximum (FWHM) in resolving individual nanoparticles under excitation at 561 nm, using plasmonic scattering as readout with the benefit of the modified STED technique. Compared to the STED microscopy, the power density of the inhibition laser beam to supress scattering in the periphery of the doughnut has reduced by 3 orders of magnitude. Moreover, the size-dependent scattering of gold nanospheres enables the superresolution multiplexed imaging. Our results demonstrate the feasibility of two-colour superresolution imaging using 60nm- and 100nm-sized gold nanoparticles as scattering probes, and excite the labelled cell with 561nm and 775nm laser beam, respectively. The superresolution multiplexed images with resolution of 150 nm in two channels are successfully obtained to resolve nanometer-sized features inside cells.

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