Super-resolution Microscope Based on Laser Scanning and a Microsphere Lens

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Optical microscope has played an important role in the many fields, such as biology and material study. Because of the wave nature of light, the resolution of optical microscope is limited by diffraction limit, about $\lambda/2$ in practice, and that prohibits one from observing more detailed structure of the sample. In the last decade,, some techniques have been developed to overcome the limit, including stimulated emission depletion microscopy (STED), near-field scanning optical microscopy (NSOM), superlens, etc.

However, these methods require high-intensity laser luminescence, sample stability, and specific operating condition, respectively. As a consequence, they suffer from phototoxicity, slow acquisition, and sample applicability.. Recently, a new method was proposed [1], which combined a dielectric microsphere with a white light source to achieve far-field super-resolution microscopy. Since confocal microscopy is able to give better contrast than bright-field microscopy, here we experimentally demonstrate the combination of dielectric microsphere and confocal laser scanning microscopy to provide super-resolution capability. The field of view and magnification of microsphere are determined. Comparing to other super-resolution techniques, this method can work without fluorescence, high-intensity laser, or specialized sample preparation. Moreover, the transferability of microsphere is also demonstrated in this study. This technique can be easily implemented with a confocal microscope and shows the potential of high-resolution biological cell observation.

Reference

[1] Wang, Z.B., et al., Nature Communications, 2011. 2.