Optical nonlinear endoscopy for 3D tweezing

Min Gu and Hongchun Bao

Centre for Micro-Photonics, Faculty of Engineering & Industrial Sciences, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia

mgu@swin.edu.au

Optical tweezers using an attractive or a repulsive force from a highly focused laser beam to physically hold and move microscopic objects provide a very useful tool for biomedical research [1-3]. It has been widely used to trap cells, molecules, viruses and bacteria for measuring the visco-elastic properties of biopolymers, characterising molecular-scale biological motors, studying locomotion and mechanical action within a cell, observing the forces and dynamics of nanoscale motors at the single-molecule level [1-3]. Despite the widespread application of optical tweezers, the instrument of optical tweezers is still based on a bulky transmitted microscopy system. Such a system does not have the movement flexibility and is significantly limited for in vivo applications especially for manipulating at cells or molecules of inner organs. In addition, optical tweezers has to employ a high numerical aperture (NA) microscope objective to generate a tight focused beam for obtaining a high electric field gradient to induce a large trapping force. Such a high NA objective is bulky and has a limited working distance, which places a hurdle for 3D trapping using at human or live animals. Optical endoscopy with the use of a small detection probe together with a thin optical fibre enables in vivo imaging and measurement [4]. Here, we report on 3D trapping of nano bio-markers by our handheld nonlinear endoscope (Fig. 1). The optical nonlinear endoscope has shown high trapping force in large-volume 3D trapping through two-photon absorption.

![Figure 1](image)

Figure 1 (A) Optical tweezing by nonlinear endoscopy. (B)-(I) Randomly located fluorescent particles were moved through two-photon absorption and positioned in a letter “B”.

References: