Rotation of a Trapped Blood Cell Using a Dual-Beam Optical Tweezer

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Abstract: We construct an infrared optical tweezer, which can trap and move blood cells. Furthermore, we demonstrate the technique of rotating blood cells by using a cover slide to let the laser beam become closely spaced dual beams.

1. Introduction

We use a linearly polarized infrared diode laser of wavelength at 980 nm as the light source to construct a flexible optical tweezer. With this conventional single-beam optical tweezer, we can trap and move blood cells or other micro particles. To rotate the trapped micro particles [1,2], we propose and demonstrate a convenient method of reforming the single laser beam into a pair of closely spaced dual beams.

2. Experimental System

Figure 1 shows the experimental setup. The output light of a fiber-coupled diode laser is delivered by an optical fiber and then collimated by an aspheric lens. The output laser beam is expanded by a pair of lenses and directed into a polarizing beam splitter. We launch the reflected light beam into an immersion-oil 100X microscope objective to form a tightly focused beam which can trap a micro particle by the gradient field force. A white light LED is used to illuminate the micro-particle sample and the microscope image is captured by a CCD camera.

Next, by inserting a cover slide [Fig. 2(a)] into half the single laser beam [Fig. 2(b)] and adjusting the phase difference between the two semi-beams to an odd multiple of π by a rotation stage, we can obtain closely spaced dual beams [Fig. 2(c)] at the laser focus. As a result, we can manipulate and rotate the blood cell by rotating the cover slide situated in a rotary mount to change the angular displacement of the two split beams.

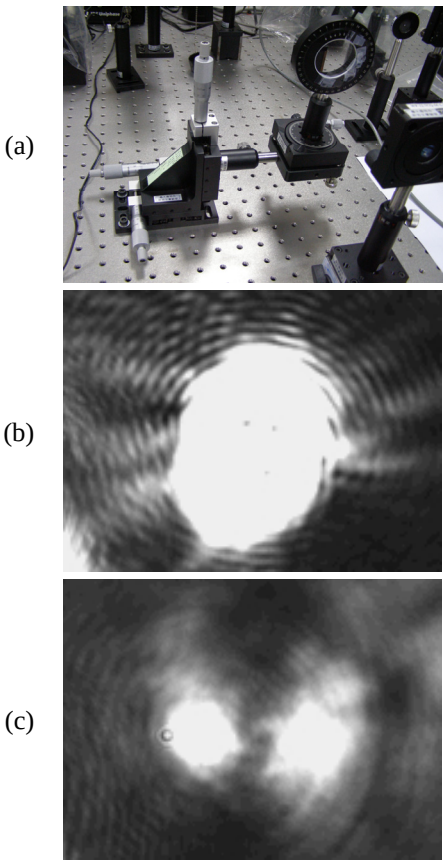

Fig. 2. (a) The cover slide and the stages. (b) The single laser beam. (c) The dual beams.

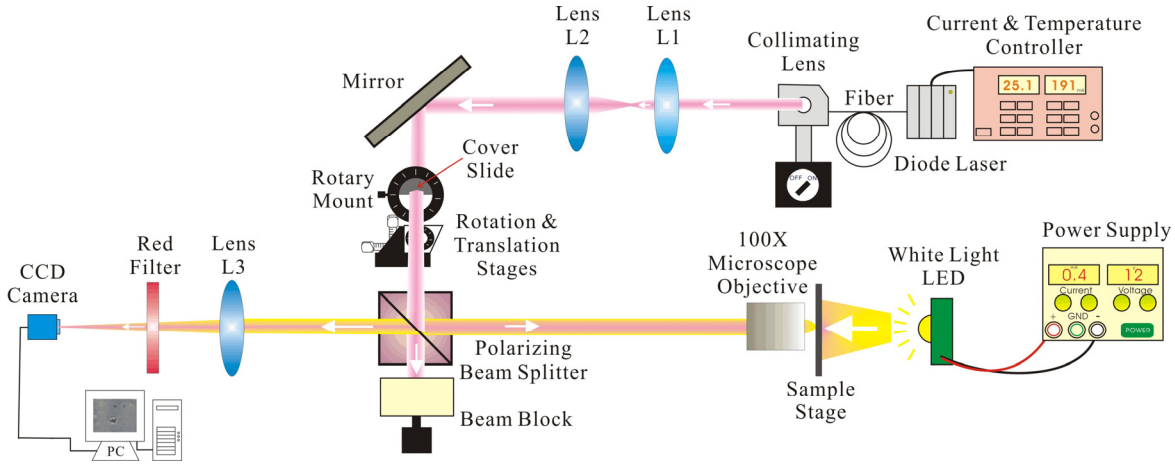

Fig. 1. The experimental setup.

3. Experimental Results

The consecutive observed images of the rotated red blood cell are shown in Fig. 3 at an interval of 45 degrees under an incident laser power of 25 mW approximately.

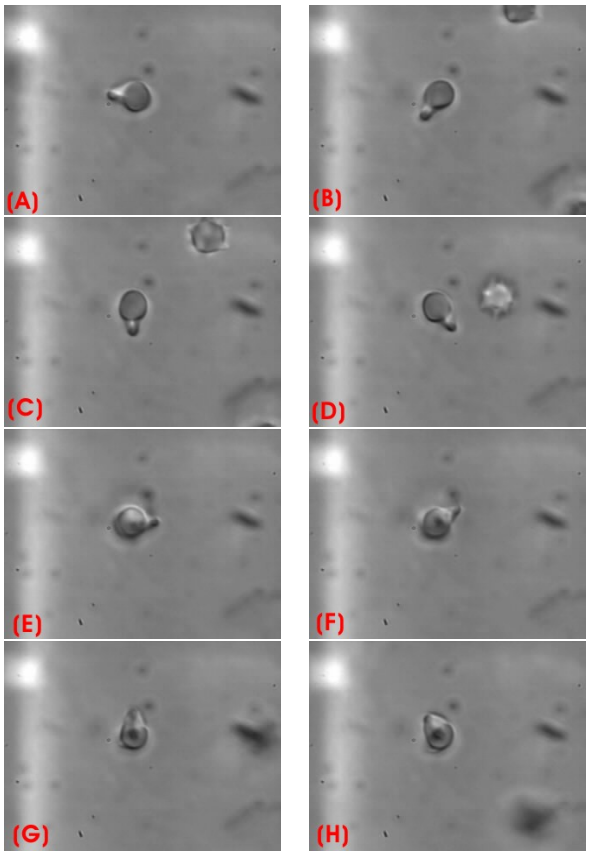

Fig. 3. The controlled rotation of the red blood cell trapped by a dual-beam optical tweezer.

4. Conclusions

In conclusion, the controlled rotation of a trapped blood cell is achieved using an easy-to-reform dual-beam optical tweezer.

5. References

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[2] V. Bingelyte, J. Leach, J. Courtial, and M. J. Padgett, "Optically controlled three-dimensional rotation of microscopic objects," Appl. Phys. Lett. **82**, 829-831 (2002).

6. Acknowledgments

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