

Optical tweezers and their application in biomedicine

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Abstract

The theory of light pressure was introduced by James Clerk Maxwell in 1873. The fact that light might exert optical force was confirmed experimentally in 1900 by the Russian physicist Piotr Lebedev. A significant breakthrough in the study of optical forces occurred only after the appearance of lasers. Arthur Ashkin was a pioneer of experiments with a highly focused laser beam acting on dielectric microobjects. In their paper from 1986 [1], Ashkin and colleagues described the first successful attempt of optical trapping using a single laser beam.

Optical trapping results from the small forces associated with the electric field gradient acting on the dielectric microparticles located in the focused laser beam. Laser beams with powers of hundreds of milliwatts are capable of exerting forces of piconewton orders. The technique of optical trapping is applicable in many fields of science. Within a few years from the publication of the work of Ashkin *et al.*, numerous laboratories around the world have begun many interesting studies.

Optical tweezers can be used to manipulate non-living and living matter. It soon turned out that the optical trapping technology allows carrying out previously unattainable tests on the microscale. The possibility of a non-invasive and sterile hold of micro-objects, e.g. cells or biomolecules, has found particular applications in biology and medicine.

About the presenter

Sławomir Drobczyński received the Ph.D. degree in 2006 and the D.Sc. degree in 2019 in physics from Wrocław University of Science and Technology, Wrocław, Poland. He is currently an Associate Professor at Wrocław University of Science and Technology in the Department of Optics and Photonics. His scientific interests are focused on methods of holographic generation of optical traps, using video cameras and image analysis to track the trajectory and dynamics of trapped objects, and the use of optical tweezers for measuring physical parameters in microscale.

References

- [1] A. Ashkin, J. M. Dziedzic, J. E. Bjorkholm, and Steven Chu. Observation of a single-beam gradient force optical trap for dielectric particles. *Optics Letters*, 11(5):288–290, May 1986.