DOUBLE WAVELENGTH MULTIFUNCTIONAL OPTICAL TWEEZERS

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The experiment conducted by Artur Ashkin in 1970 at Bell Laboratories showed the possibility of a stable trap of micro-objects by means of a laser beam and basically gave rise to the technique of optical manipulators. Optical trapping results from the small forces associated with the electric field gradient acting on the dielectric microparticles located in the focused laser beam. 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 application in biology and medicine. Using the optical manipulator for new applications, however, forced the functionality of the system to be increased by adding new modules or techniques, e.g. imaging in fluorescence mode, spectroscopic track, hypoxia chamber, etc.

The presented multifunctional optical manipulator system is characterized by the possibility of simultaneous generation of traps of different wavelengths and two methods of directing the laser beam depending on the requirements for the desired trap power. The holographic method is used to simultaneously control many laser beams of different wavelengths. They can selectively initiate photochemical processes (e.g. photodynamic generation of free radicals) and photophysics (e.g. photoluminescence). In turn, the method of directing a high-power laser beam using a galvan-mirror allows catching and manipulating relatively large objects. As the energy of the laser beam increases, the strength of the optical trap increases. Strong traps allow moving cells, cell conglomerates and study the interaction between them (e.g. intercellular adhesion forces).