P1.10

Computation of optically induced forces and torques arising in connection with holographic optical assembly

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The finite-difference time-domain (FDTD) and T matrix approaches are used to calculate the forces and torques that can be applied to small particles by holographically generated focused laser beams, as part of a study of the physical limitations involved in the construction of micro- and nanostructures using a dynamic holographic assembler (DHA). We consider dielectric, metallic and optically anisotropic materials, as well as variations in particle shape, homogeneity and refractive index. We employ a full 3-dimensional FDTD implementation, which includes a complete treatment of optical anisotropy. We model the trap as a non-paraxial Gaussian beam, sourced using a multipole expansion. The method is general and permits the simulation of several traps simultaneously. Forces and torques are calculated for pairs of silica spheres in adjacent traps, for silica cylinders trapped by multiple beams and for oblate silica spheroids and calcite spheres in both linearly and circularly polarized beams. Comparisons are drawn between the magnitudes of the optical forces and the Van der Waals forces acting on the systems. We also consider the limitations of the FDTD approach when applied to optical trapping. Where appropriate, agreement between the FDTD and T matrix methods is demonstrated.

P1.11

Two-dimensional finite aperture diffractive optical elements design using iterative angular spectrum approach

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The iterative angular spectrum approach (IASA) has been introduced by Mellin and Nordin to design one-dimensional finite aperture diffractive optical elements (1D-FADOE) with minimum feature size in the order of wavelength. Two dimensional (2D) cases that have some kinds of symmetry in their desired intensity distribution can be designed indirectly using the 1D approach, but cases with asymmetric intensity distribution cannot be designed using this method. We have used an extended version of the IASA to design 2D-FADOE directly. As specific examples, we have designed three FADOE. The first example is a 1-to-7 beamfanner to couple an incident beam of light to seven single mode optical fibers evenly. The second example is a beam flattener that converts a Gaussian laser beam into a flat beam. The diameters of the input and output beams are assumed to be 26 mm and 5.3 mm, respectively. The third example is a 1-to-3 beamfanner that divides the input beam into three output beams unevenly. The three output beams are located at the corners of an arbitrary triangle and have power ratios of 20%, 30% and 50%. In all three examples, the observation plane is located at the near field region. The results obtained show that the extended method is powerful in designing 2D-FADOE.