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Special Section Guest Editorial: Optical Manipulation and Structured Materials

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Conventional optical tweezers rely on the field gradients near the diffraction limited focus of a laser beam. Dielectric particles with a dimension ranging from hundreds of nanometers to tens of micrometers can be stably trapped by the gradient force at the beam focus. However, this optical technique does not always allow efficient trapping and manipulation of particles at the nanoscale because the gradient force scales with the volume of the particle. It is thus highly desirable to develop novel trapping geometries and materials that can significantly reinforce the interaction between optical fields and trapping materials at this length scale. Recently, near-field optical trapping techniques (e.g., using metamaterials and plasmonic and photonic crystals) have enabled the optical manipulation of nanoparticles at dimensions beyond the diffraction limit and have made it possible to trap single biomolecules. Furthermore, structured light fields (e.g., optical vortices, vector beams, and nondiffraction beams) have played an important role in understanding more complex light-matter interactions, including the transfer of spin and orbital angular momentum of light to matter. This special section comprises six contributed articles, which should enable us to further understand the interplay between structured light fields and structured materials on a subwavelength scale for advanced optical manipulation.

[Mansuripur](#) theoretically investigated the exchange of linear and angular momentum from an electromagnetic wave-packet to a small spherical particle and revealed different optomechanical responses when the particle absorbed energy from the incident light. [Setoura et al.](#) applied fluorescence correlation spectroscopy to monitor the temperature around a trapped particle with numerical simulations. [Leménager et al.](#) investigated the trapping characteristics of a range of nanoparticles including spherical YAG:Ce³⁺ and NaYF₄:Er³⁺, Yb³⁺ nanorods in optical fiber tweezers. [Sun et al.](#) reported on a surface plasmon resonance imaging technique using a three-dimensional plasmonic microwell array to enhance the electromagnetic field response. [Anbardan et al.](#) introduced a technique to synchronize two cavity solitons in a driven vertical cavity surface emitting laser above threshold. Furthermore, structured light-matter interactions enabled the fabrication of novel material structures. [Minowa et al.](#) fabricated cadmium selenide quantum dots using a pulsed laser-ablation scheme in superfluid helium.

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