Optical trapping and manipulation of nano- and micro-objects

S. Carretero Palacios[1,2], L. Osinkina[2], M. Fedoruk[2], S. R. Kirchner[2], S. Nedev[2], T. Lohmüller[2], F. Jäckel[2,3], J. Feldmann[2]

[1]*Present Address: Instituto de Ciencia de Materiales de Sevilla (CSIC-Universidad de Sevilla) C/ Américo Vespucio 49, 41092 Sevilla, Spain*
[2]*Photonics and Optoelectronics Group, Department of Physics and Center for NanoScience (CeNS), Ludwig-Maximilians-Universität München Amalienstaße 54 80799 Munich, Germany*
[3]*Department of Physics and Stephenson Institute for Renewable Energy, University of Liverpool, Chadwick Building Peach Street, L69 7ZF, Liverpool, UK*

sol.carretero@csic.es

Abstract:
Since the discovery of optical trapping by Ashkin [1] in 1970, an ever increasing use of optical tweezers as sensitive tools for the manipulation and observation of isolated nano- and microobjects in aqueous solution has been reported. Optical tweezers employ a focused laser beam to exert small forces on an object of interest, and, depending on the relative contribution of scattering and gradient forces, laser light can be used for either stable optical trapping of the object or for depositing it at desired locations on a substrate. An important advantage of optical trapping is the contactless nature of optical forces, which enables straightforward integration of optical trapping with optical imaging and spectroscopic techniques. Nowadays, optical trapping and optical manipulation of micro- and nanostructures are standard techniques widely used in biology, physics, chemistry, and material sciences. In this talk, we will review some examples of our recent investigations using optical tweezers [2], ranging from the study of DNA-binding events [3], direct optical monitoring of flow generated by artificial dipole-like microobjects or bacterial flagellar rotation [4], to the fine control of heat-induced polymerization reactions at the nanoscale [5].

References:
[1] “Acceleration and Trapping of particles by radiation pressure”, A. Ashkin, Phys. Rev. Lett. 24, 156 (1970)
[2] “Optical trapping and manipulation of plasmonic nanoparticles: fundamentals, applications and perspectives”, A.S. Urban et al. Nanoscale 6, 4458-4474 (2014)
[3] “Tuning DNA Binding Kinetics in an Optical Trap by Plasmonic Nanoparticle Heating”, L. Osinkina et al., Nano Lett. 13, 3140 (2013)
[4] “Direct optical monitoring of flow generated by bacterial flagellar rotation”, Silke R. Kirchner et al., Appl. Phys. Lett. 104, 9 (2014)
[5] “Nanolithography by Plasmonic Heating and Optical Manipulation of Gold Nanoparticles”, Michael Fedoruk et al., ACS Nano 7, 7648 (2013)