Displacement trajectory of gold nanoparticles under photonic hook

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The trapping and manipulation of particles by optical tools have been widely used in biological research and implemented in medicine [1], yet nanoscale objects cannot be manipulated by such tools due to the diffraction limit of light [2]. Therefore, achieving manipulation on the nanoscale requires auxiliary structures that generate a tightly confined electric field. Photonic nano-jets are high intensity, narrow light beams generated by dielectric structures that are subjected to illumination by a plane wave [3]. When the symmetry is broken, the generated structured light becomes curved, which is known as a photonic hook effect [4]. Here, we report the displacement trajectory of gold nanoparticles under photonic hook force generated with pulsed light beam. The studied system is composed of a micro-cylinder and metallic mask that partially blocks the incident light and creates an asymmetric illumination [5]. We show that the optical forces generated using pulsed illumination are five orders of magnitude higher than forces generated under continuous-wave illumination, and result in the displacement of a gold nanoparticle. Our findings open a way for practical opto-mechanical manipulation of nanoparticles.

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