Optical heating and manipulation of a single metallic nanoparticle

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A precise control over individual nanoparticles has huge potential for nano-architectural purposes and for probing nano-scale interactions. However, the absorption and heating associated with resonant irradiation of an individual gold nanoparticle can be extreme.

Moreover, the heating of a nanoparticle cannot be theoretically predicted as the precise focal intensity distribution on the nanoscale is unknown and typically highly aberrated [1]. Utilizing a novel assay based on partitioning of lipophilic dyes between membrane phases we quantify the heating of an individual irradiated gold nanoparticle [2,3]. The heating of the particle is dependent on laser power, and for a nanorod, also on its orientation with respect to the laser polarization [4]. A dramatic and irreversible change in plasmonic behavior of a nanorod occurs at high illumination intensities as the nanorod restructures into a more spherical shape. Nanoparticles can be used inside living cells for precise force measurements [5], and the photo-thermal effect of metallic nanoparticles can be used to create localized heat gradients inside living cells thus investigating cellular responses to heat chocks.

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