# Optically controlled electron excitation and thermal management on the nanometer length scale

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The manipulation of polymers and biological molecules or the control of chemical reactions on the nanometer scale by means of laser pulses shows great promise for applications in modern nanotechnology, biotechnology, molecular medicine or chemistry. A controllable, parallel, highly efficient and very local energy conversion of ultrashort laser pulse energy to kinetic electron energy at a metal nanoparticle and in a second step, the heat conversion of the kinetic electron energy in a metallic nanoparticle without ablation or fragmentation will provide an important tool in microscopy.

In this talk we present theory as well as experiments of interaction the laser radiation with gold nanoparticles on a polymethylmethacrylate (PMMA) layer (one photon excitation) by means of different laser pulse lengths, wavelengths and pulse repetition rates. We show the possibility of highly local (in a 40 nm range) regulated electron excitation and heat insertation into the nanoparticle and its PMMA surrounding without ablation of the gold nanoparticles. Furthermore we use silver enhanced gold nanoparticles on DNA (also within chromosomes) as energy coupling antennas for femtosecond laser radiation with two photon excitation. We show highly localized destruction effects on chromosomes highly localized closely the nanoparticles (see Fig.1). Surprisingly, we find that a stretched DNA on top of PMMA with a coupled silver nanoparticle was manipulated by fs-laser irradiation. This is not the case in the absence of metallic nanoparticles.

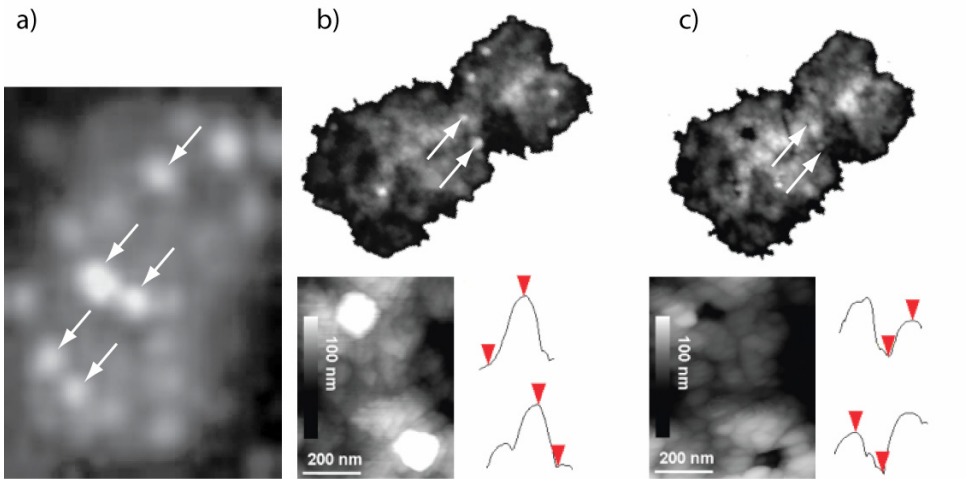


**Fig. 1:** Metaphase chromosomes sequence specifically labeled with silver enhanced gold nanoparticles shown in optical dark field contrast microscopy **(a)**. AFM images of nanoparticles coupled to chromosome surface before **(b)** and after **(c)** laser irradiation. Pictures below **(b), (c)** are zooms of marked particle on chromosome and section analyses.

## References:

F.Garwe et. al. Medical Laser Application 20, p201 (2005)
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