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Simulation of photoinduced Near-field heating a gold tapared nanoantenna

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Abstract

We report on simulations of laser-induced heating in the gold nanotip. The simulation was carried out using the Lumerical software. Highly enhanced optical field can indunced thermal transport in nanotip under laser irradiation. This resulting localized heating effect are of great interest which promise novel applications in material surface processing. The optical field distribution around the tip calculated by solving the Maxwell equations by the finite-difference method in the time domain. A gold nanoparticle was modeled as a simplifed model of a probe to verify the validity of simulation results.

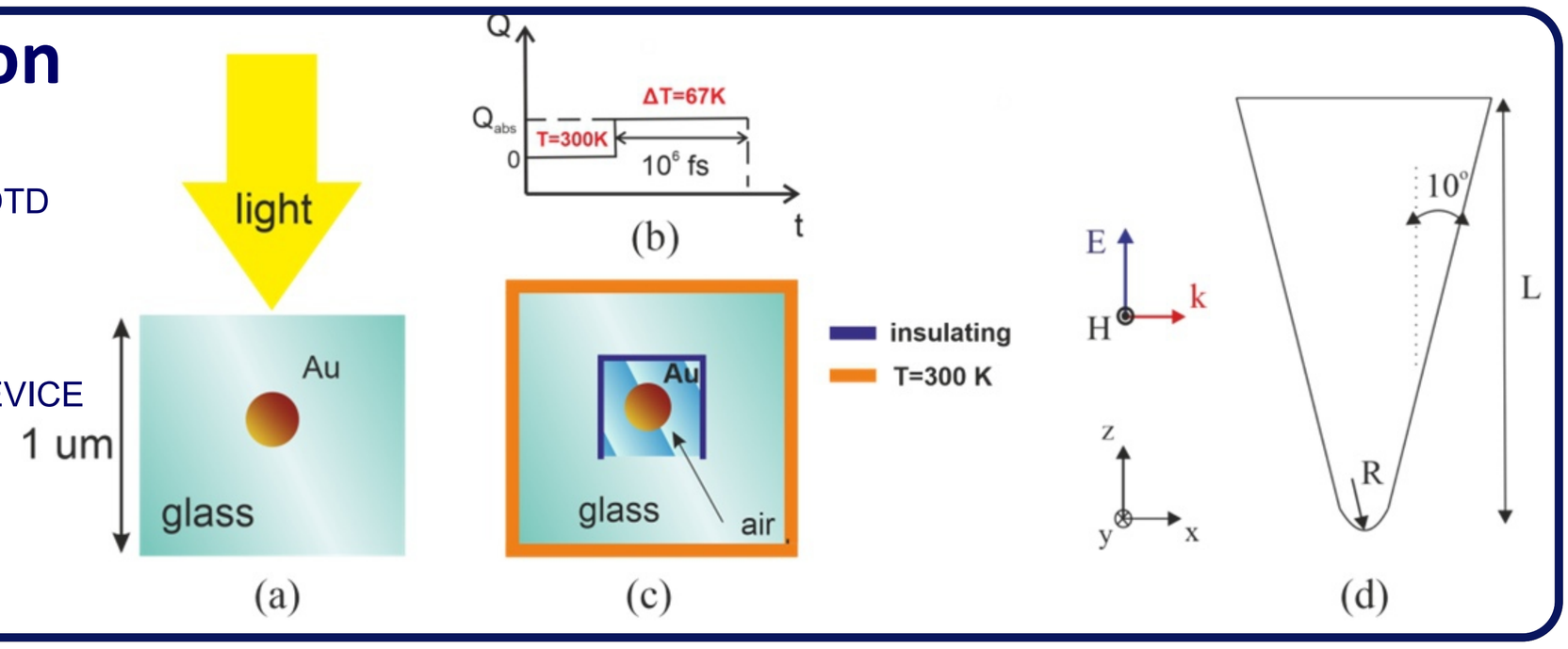
Geometry of simulation

a) Schematic of the system simulated in the FDTD Lumerical

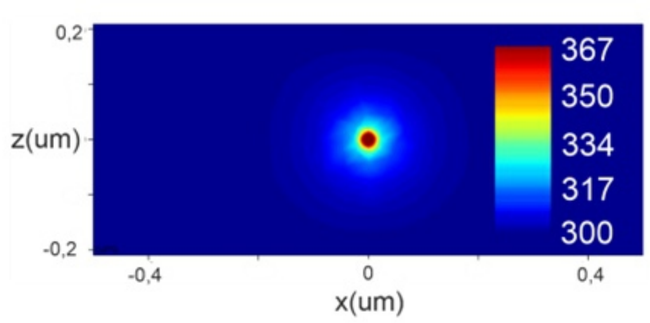
b) Light pulse switching circuit

c) Schematic of the system simulated in the DEVICE Lumerical

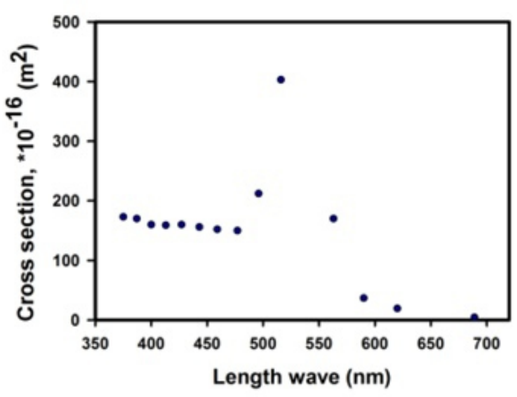
d) Schematic of the free-standing tip



Results



(a)



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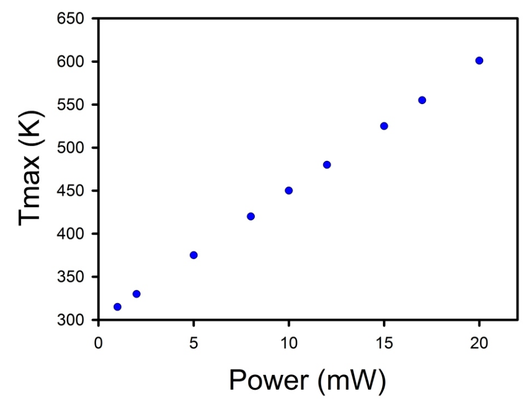
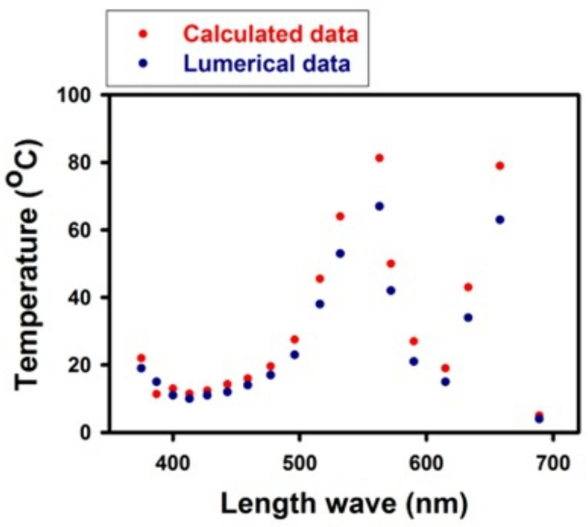
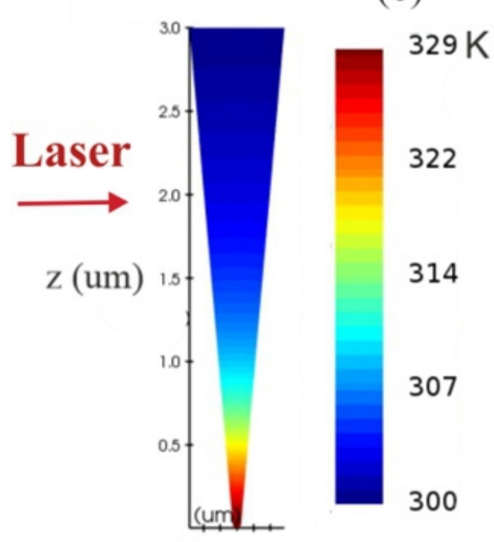


(e)



(b)



(d)

a) Temperature map of gold nanoparticle (incident wavelength 563 nm);

b) Dependence of the absorption cross section of gold nanoparticle on the wavelength of incident radiation;

c) Dependence of the heating temperature of gold nanoparticle on the wavelength;

d) X-Z cross section view of the temperature distribution;

e) Dependence of the maximum heating temperature of the probe on the power of the incident radiation (633 nm) for R=25 nm.

Conclusion

1) The maximum temperature change of a gold nanoparticle with a radius of 10 nm is achieved at a wavelength close to the plasmon resonance wavelength. The temperature values are 81 K (in the case of modeling in the Lumerical software) and 67 K (in the case of the calculated values).

2) The maximum heating temperature is reached at power of 20 mW and is 601 K for R=25 nm.

References: Downes, A. [et al.] // *Optics Express* (2006).
Zhang, W. [et al.] // *J. Phys. Chem. C (2008).*

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