Designing plasmonic structures for an optimized local thermo-optical response

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Abstract

Nowadays, efficient local heat generation using metallic nanoparticles is a research field of growing interest. These optically excited plasmonic structures often show large resistive losses and are therefore capable of converting optical energy into heat efficiently [1]. The spatial distribution and the magnitude of the obtained temperature mainly depends on the geometry and composition of the nanoparticles; thus, different nanostructures can be designed to act as nanoheaters, opening a wide range of fascinating applications. Some examples are the degradation of micropollutants [2] or plasmonic photothermal therapy [3].

These applications often require biocompatible materials and a high particle tunability to resonate in the target wavelength domain. Here, we present our most recent investigation on this topic, showing an exhaustive comparison of different efficient and tunable nanoheater prototypes.

References

[1] G. Baffou. Thermoplasmonics: Heating Metal Nanoparticles Using Light. Cambridge: Cambridge University Press, 2017.

[2] H. Wei, Stephanie K. Loeb, Naomi J. Halas, J. Kim. PNAS 117 (2020) 15473-15481.

[3] André M. Gobin, Min Ho Lee, Naomi J. Halas, William D. James, Rebekah A. Drezek, and Jennifer L. West. Nano Letters 7 (2007), 1929-1934.

Figures

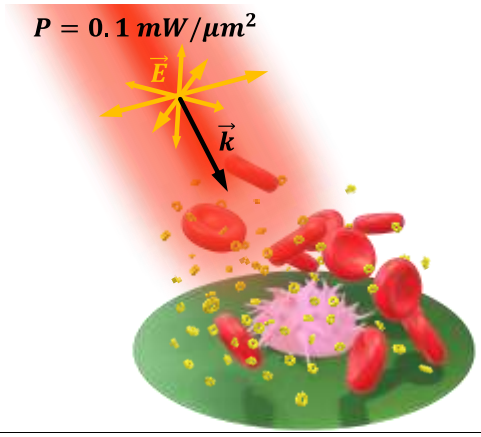

Figure 1: Illustration of blood red cells and cancerous cells being treated with toroidal particle-assisted photothermal therapy.

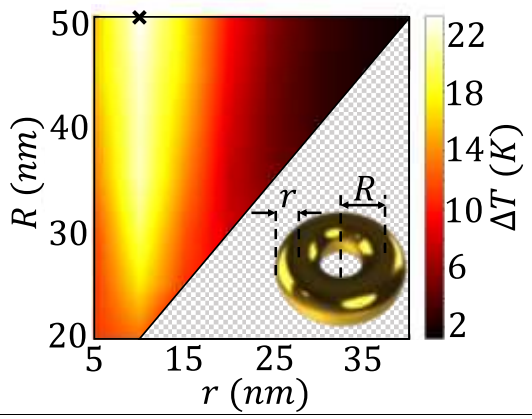

Figure 2: Colormap of the maximum temperature increment reached by a set of toroidal particle designs.