Near-field radiative heat transfer at the nanoscale

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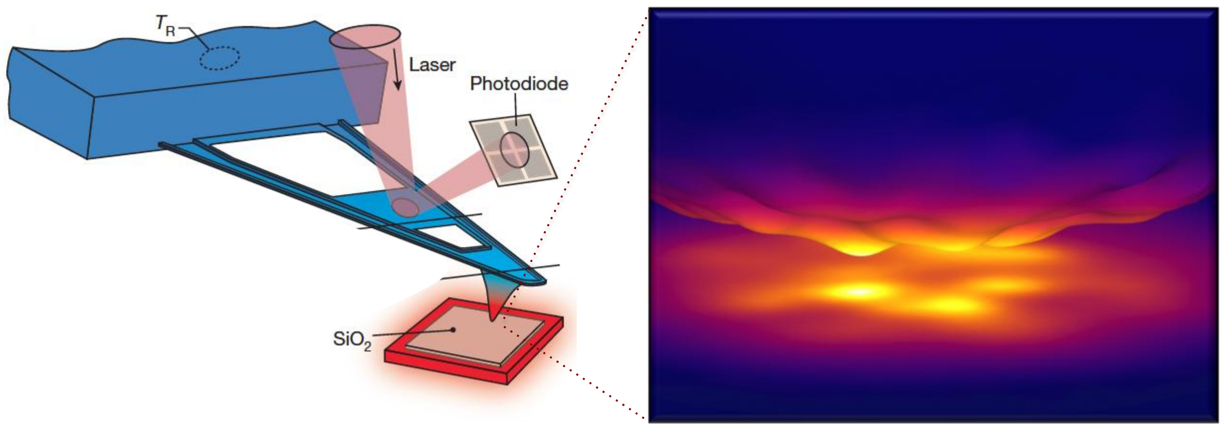
Abstract

Radiative heat transfer between objects at different temperatures is of fundamental importance in applications such as energy conversion, thermal management, lithography, data storage, and thermal microscopy. It was predicted long ago that when the separation between objects is smaller than the thermal wavelength, which is of the order of 10 μm at room temperature, the radiative heat transfer can be greatly enhanced and it can even overcome the theoretical limit set by Stefan-Boltzmann law for black bodies. This is possible due to the contribution of the near field in the form of evanescent waves (or photon tunneling). In recent years, different experimental studies have confirmed this long-standing theoretical prediction. However, in spite of this progress, there are still many basic open questions in the context of near-field radiative heat transfer. In this talk, I will review our recent theoretical and experiment efforts to shed new light on the problem of thermal radiation exchange at the nanoscale. In particular, I will discuss the following two fundamental issues: (i) The enhancement of near-field radiative heat transfer in polar dielectric thin films [1] and (ii) the radiative heat transfer in the extreme near-field regime when objects are separated by nanometer-size distances [2].

References

[1] B. Song, Y. Ganjeh, S. Sadat, D. Thompson, A. Fiorino, V. Fernández-Hurtado, J. Feist, F.J. García-Vidal, J.C. Cuevas, P. Reddy, and E. Meyhofer, Nature Nanotechnology **10**, 253 (2015).
[2] K. Kim, B. Song, V. Fernández-Hurtado, W. Lee, W. Jeong, J. Feist, M.T.H. Reid, F.J. García-Vidal, J.C. Cuevas, E. Meyhofer, and P. Reddy, Nature **528**, 387 (2015).

Figures



Radiative thermal radiation between an AFM tip and a surface both made of SiO_2 and separated by a few nanometers.