Ultrafast Processes Triggered by Plasmon Fluctuations

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Thermal fluctuations of the electromagnetic field produce phenomena such as radiative heat transfer and free-space friction that we have studied in my group over the last few years [1, 2, 3]. When plasmon-supporting structures are involved, the electromagnetic field can strongly hybridize with these collective electron excitations, giving rise to energy concentration down to the nanoscale, which is understandably accompanied by strong interaction between these excitations compared to more delocalized propagating photons. For sufficiently small structures, the magnetic part of the interaction becomes irrelevant and the systems behave quasistatically, with no limit to the confinement and strength of the interaction other than the extension the electron wave functions involved in the plasmons. We have explored this regime and found the surprising result that plasmon-mediated heat transfer can become a dominant channel of heat evacuation compared with electron-phonon coupling and electron diffusion. In this talk, I will present an overview of the so-called noncontact heat transfer and discuss the regime in which it becomes ultrafast, so that a substantial amount of electronic heat is transferred between neighboring structures within hundred of femtoseconds. I will also discuss other general implications of plasmon fluctuations and some potential applications.

References

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