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**Quantum Plasmonics and Nanoscale Gap Plasmons with graphene, semiconductors and molecules**

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Coupling between plasmonic nano-components generates strongly red-shifted resonances combined with intense local field amplification on the nanoscale. We have combined plasmonics with soft materials to tune this interaction dynamically, accessing the strong coupling domain for gaps below 1nm, reliably made by bottom-up self-assembly. At these distances coupled dipoles cannot describe the response, and a better account comes from gap plasmons. Crucial is the extreme sensitivity to separation, and how quantum tunneling starts to play an influence that can be directly seen at room temperature in ambient conditions. We recently demonstrated how quantum plasmonics controls the very smallest space that light can be squeezed into. We also demonstrate the possibility to track few molecules using surface-enhanced CARS. A new generation of 2D semiconductors coupled to such nano-scale gaps utilizes a nanoparticle on mirror geometry.

[1] *Nature* **491**, 574 (2012); Revealing the quantum regime in tunnelling plasmonics.
[2] *Nano Letters* **10**, 1787 (2010); Actively-Tuned Plasmons on Elastomeric Au NP Dimers.
[3] *ACS Nano* **5**, 3878 (2011); Precise sub-nm plasmonic junctions within Au NP assemblies.
[4] *Nano Lett* doi:10.1021/nl4018463 (2013); Controlling Sub-nm Plasmonic Gaps using Graphene.