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Watching Single Molecules in Nm-scale Plasmonic Cavities

Abstract: Coupling between plasmonic nano-components generates strongly red-shifted resonances combined with intense local field amplification on the nanoscale. This allows directly seeing molecules as well as excitations in semiconductors. We have recently explored plasmonic coupling which can be tuned dynamically, through reliable bottom-up self-assembly. The crucial aspect of these systems is the extreme sensitivity to separation, and how quantum tunneling starts to 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 the extreme enhancements. We show how the new generation of 2D semiconductors can couple to such nano-scale gaps utilizes our nanoparticle on mirror geometry. We find that changing just a single atom on each molecule of a self-assembled monolayer can shift the plasmon by over 50nm, and produce surprising vibrational signatures. These have encouraging prospective applications in (bio)molecular sensing as well as fundamental science.

Bio: Professor Jeremy J. Baumberg, directs a UK Nano-Photonics Centre at the University of Cambridge and has extensive experience in developing optical materials structured on the nano-scale that can be assembled in large volume. He is also Director of the Cambridge Nano Doctoral Training Centre, a key UK site for training PhD students in interdisciplinary Nano research. Strong experience with Hitachi, IBM, his own spin-offs Mesophotonics and Base4, as well as strong industrial engagement give him a unique position to combine academic insight with industry application in a two-way flow. With over 10000 citations, he is a leading innovator in Nano. This has led to awards of the Royal Society Rumford Medal (2014), IoP Young Medal (2013), Royal Society Mullard Prize (2005), the IoP Charles Vernon Boys Medal (2000) and the IoP Mott Lectureship (2005). He frequently talks on NanoScience to the media, and is a strategic advisor on NanoTechnology to the UK Research Councils. He is a Fellow of the Royal Society, the Optical Society of America, the Institute of Physics, and the Institute of NanoTechnology.