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# Controlling Light at the Nano-Scale via Molecular Tunnel Junctions

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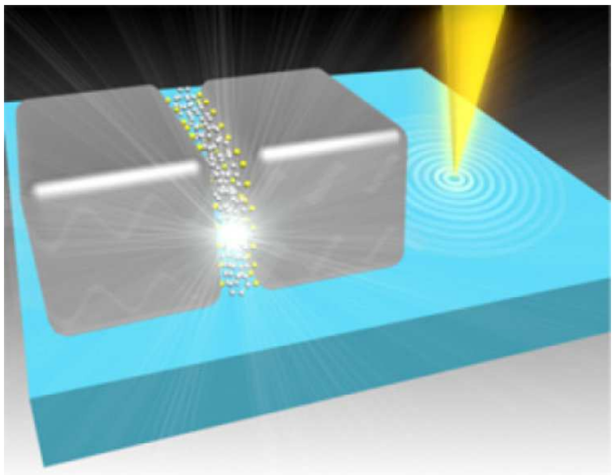
During the talk I will discuss our recent progress in the development of molecular tunnel junctions based on self-assembled monolayers (SAMs) and how we apply them as electrical excitation sources of plasmons and to identify new plasmon modes (i.e., the tunneling charge transfer plasmon mode).

First, I will give a brief introduction to bottom electrode—SAM—top electrode junctions and the challenges in how to fabricate them reliably and reproducibly. We developed a platform based on top-electrodes of a non-invasive liquid-metal that forms stable features in microchannels. This liquid-metal alloy (a mixture of Ga and In stabilized by a conductive 0.7 nm thick layer of $GaO_x$) forms good electrical contacts with SAMs.[1-4] This platform forms the basis to electrically excite plasmons at the gold bottom-electrode—dielectric interface. We show that the current does not flow uniformly across the junctions and consequently plasmons are excited in discrete spots. We are able to study to optical properties as function of bias in real-time which enables us to elucidate the dynamic behavior and to investigate the nature of these point sources.



In the second part of the talk, I will describe the direct observation of, and control over, quantum plasmon resonances at length scales in the range of 0.4 – 1.3 nm across molecular tunnel junctions made of two plasmonic resonators bridged by SAMs (see Figure).[5] We could control the frequency of the tunneling charge transfer plasmon mode by simply changing the chemical structure of the junctions.

Our results show that molecular electronics combined with plasmonics makes it possible to control plasmonic properties and to study new phenomena at the molecular length-scales.

**References**

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