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Systematic Investigation of the Gold Photoluminescence in Nanoscale Antennas TONI FROEHLICH, CHRISTIAN SCHOENENBERGER, MICHEL CALAME, University of Basel — Nanoscale dipole antennas are interesting systems to study electric field enhancement effects. Within the gap between both antenna arms, a very strong electric field arises, which can stimulate molecules present in the gap. This enhanced electric field is well suited for the optical characterization of molecules, such as in surface enhanced Raman scattering. We study gold antennas which are lithographically fabricated on thermally oxidized silicon. A confocal laser microscope was used to investigate their single-photon photoluminescence (PL). The photoluminescence of a monopole antenna follows well a model proposed by Boyd *et al.* [1] if the energy peak position (E_{max}) is above the interband absorption edge (1.7–1.8 eV) of gold. The PL spectra of dipole antennas show a red-shift of E_{max} for decreasing gap sizes. We relate this behaviour to the increased coupling of individual arms via their optical near-field. The PL spectra are highly dependent on the shape of the antenna. For increased length or aspect ratio, we observe a decrease in the energy value E_{max}. We can accurately fit these spectra to the model [1] and estimate the dielectric properties of the environment. Interestingly for long antennas the spectra deviate from the model and show an additional peak. The latter peak show no geometrical dependence and remains at the energy value of the interband absorption edge. Our studies set the basis for future experiments on antennas embedding optically-active molecular compounds.

[1] G. T. Boyd *et al.*, Physical Review B (33), 7923, 1986

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