Bio-inspired nanoantennas for light emission

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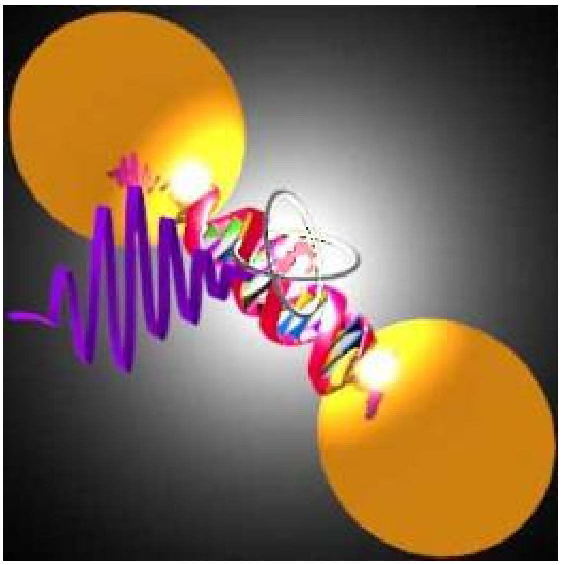

Schematic representation of a nanoantenna formed of two gold nanoparticles linked by a DNA double strand and supplied by a single quantum emitter. Credit: Busson, Rolly, Stout, Bonod, Bidault

Just as radio antennas amplify the signals of our mobile phones and televisions, the same principle can apply to light. For the first time, researchers from CNRS and Aix Marseille Université have succeeded in producing a nanoantenna from short strands of DNA, two gold nanoparticles and a small fluorescent molecule that captures and emits light. This easy-to-handle optical antenna is described in an article published in *Nature Communications* on 17 July 2012. This work could in the longer term lead to the development of more efficient light-emitting diodes, more compact solar cells or even be used in quantum cryptography.

Since light is a wave, it should be possible to develop optical antennas capable of amplifying light signals in the same way as our televisions and mobile phones capture radio waves. However, since light oscillates a million times faster than radio waves, extremely small nanometer (nm) sized objects are needed to capture such very rapid light waves. Consequently, the optical equivalent of an elementary antenna (of dipole type) is a quantum emitter surrounded by two particles a thousand times smaller than a human hair.

For the first time, researchers from the Langevin and Fresnel Institutes have developed such a bio-inspired light nanoantenna, which is simple and easy to handle. They grafted gold particles (36 nm diameter) and a fluorescent organic colorant onto short synthetic DNA strands (10 to 15 nm long). The fluorescent molecule acts as a quantum source, supplying the antenna with photons, while the gold nanoparticles amplify the interaction between the emitter and the light. The scientists produced in parallel several billion copies of these pairs of particles (in solution) by controlling the position of the fluorescent molecule with nanometric precision, thanks to the DNA backbone. These characteristics go well beyond the possibilities offered by conventional lithography techniques currently used in the design of microprocessors. In the longer term, such miniaturization could allow the development of more efficient LEDs, faster detectors and more compact solar cells. These nanosources of light could also be used in quantum cryptography.

More information: Accelerated single photon emission from dye molecule driven nanoantennas assembled on DNA” Mickaël P. Busson, et al. *Nature Communications*, 17 July 2012.

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