DNA origami antennas with gold and silver nanoparticles

Izabela Kaminska*, Anastasiya Puchkova, Maria Sanz Paz, Carolin Vietz, Enrico Pibiri, Bettina Wünsch, Guillermo P. Acuna, Philip Tinnefeld

Institute of Physical and Theoretical Chemistry, TU Braunschweig, Hans-Sommer-Straβe 10, 38106 Braunschweig, Germany
* Institute of Physics, Department of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5/7, 87-100 Torun, Poland

DNA-Origami has been proved to be a useful tool for precise arrangement of nanoobjects. In particular, we employ DNA platforms to organize single fluorophores and metallic nanoparticles in three dimensions. We have studied versatile and robust DNA-Origami to show distance- and angular dependences in the nanoparticle-fluorophore interactions [1, 2], or as standards for three-dimensional superresolution microscopy [3]. Highly efficient self-assembled nanoantennas of the first generation (with a 23-nanometer gap between gold nanoparticles) are able to strongly focus light into the sub-wavelength region and give intensity enhancement of a factor of about 100 [4].

Recently, we have developed a second generation nanoantennas with improved performance due to the refinement of origami structure and reduction of the distance between nanoparticles down to 12 nm (Fig. 1) [5]. It displays 5000-fold fluorescence enhancement and detection of a single molecule at concentrations as high as 25 µM. Our latest results show promises for a broad-band fluorescence enhancement by exchanging gold with silver nanoparticles. While both types give similar results in red, dimer nanoantennas based on silver are advantageous in visible range from orange to blue [6].

This work was supported by a starting grant (SiMBA, EU 261162) of the European Research Council (ERC), and the Deutsche Forschungsgesellschaft (AC 279/2-1 and TI 329/9-1). CV acknowledges support from the Studienstiftung des Deutschen Volkes, and BW from the Nanomet program GRK 1952/1 of the Deutsche Forschungsgesellschaft. IK acknowledges support from the Foundation for Polish Science.

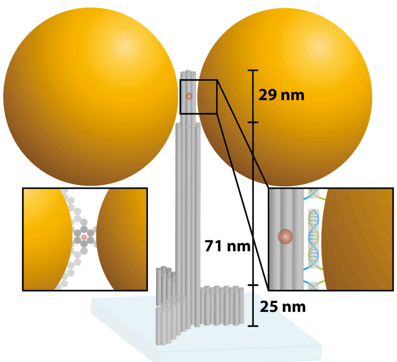

Fig. 1: Schematic illustration of the DNA-Origami based optical nanoantenna dimer with two 100 nm gold nanoparticles and an immobilized fluorophore (ATTO647N) at the hot-spot.

1. G. P. Acuna et al., ACS Nano 6 (2012) 3189-3195.
2. F. Möller et al., Nanophotonics 2 (2013) 167-172.
3. J. J. Schmied et al., Nano Letters 13 (2013) 781-785
4. G. P. Acuna et al.,Science 338 (2012) 506-510.
5. A. Puchkova et al., Nano Letters 15 (2015) 8354-8359.
6. M. Sanz Paz et al., in preparation (2016).