Decorating DNA origamis with gold nanoparticles

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Synthetic strategies to produce gold nanostructures around DNA templates have been developed over the last decade after the pioneering works of C. A. Mirkin and coworkers (Mirkin, 1996) and A. P. Alivisatos and coworkers (Alisivatos 1996). In particular, it is possible to obtain well-defined NP grouping geometries by controlling precisely the number of DNA single strands grafted on each gold particle through electrophoretic purification (Zanchet 2001, Zanchet 2002). This allows combining gold particles with other nano-objects (such as quantum dots) on the same template or producing symmetric 1D (Deng 2005) or 2D (Zheng 2006) NP lattices. However there are three major difficulties when producing DNA templated NP groupings for SERS applications : obtaining short particle spacings to enable large field enhancements ; using a rigid DNA scaffold to control precisely the grouping geometry ; introducing specific binding sites on electromagnetic hot-spots.
S. Bidault and coll. recently demonstrated that reproducible ~1nm NP spacings could be obtained in groupings of 5, 8 or 18 nm diameter particles using two DNA double strands (Bidault, 2008). Using several particles of different sizes allows optimizing field enhancement effects at one specific position of the structure (at the surface of the smallest NP) (Li, 2003). This geometry still presents two drawbacks : it is not possible to tune the spacing lengths and the three particles cannot be properly aligned to optimize field enhancements (Li,2003).
DNA origamis (Rothemund 2006) are good candidates to overcome the last two issues : controlling precisely the nanostructure geometry and introducing specific binding sites.
In this communication, we will discuss several issues, both theoretical and experimental, concerning the arrangement of gold nanobeads on such DNA constructions. In particular, we will focus on the possible optimizations that are possible as a function of the relative position of the beads or the bending of the DNA origami. We will also consider the use of surface scanning plasmon microscopy (Berguiga 2007) as a tool to characterize, by purely optical methods, the distribution of an origami deposit.

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