Hybrid self-assembly of quantum dots and gold nanoparticles driven by protein pairing

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The broad field of nanotechnology has resulted in the design of hybrid nanomaterials featuring exclusive properties such as sensing, data or energy storage and biocide activity. Molecule-driven self-assembly of biomolecules led to the design of colloidal assemblies thanks to the direct recognition of specific molecular partners grafted onto nanoparticles. Direct coupling of nanoparticles has been achieved using DNA strands hybridization, peptide coupling or archetypal protein interactions. In this context, assemblies of gold nanoparticles were designed using a pair of artificial α-Repeat proteins (Figure 1a) of high affinity exhibiting a dissociation constant in the nanomolar range.[1,2] These promising proteins induce the self-assembly of complementary colloids in a controlled manner, whilst providing a control on the interparticle distance.

Here we present the design of αRep proteins driven self-assemblies of semiconductor nanoparticles and gold nanoparticles. First, fonctionnalization of the nanoparticles is achieved exchanging an initial polycystein peptidic ligands at the surface of the NP with the αRep proteins.[3] The efficiency of the protein grafting was demonstrated by agarose gel electrophoresis. The molecular recognition properties of the protein-functionalized nanoparticles are evidenced using Surface Plasmon Resonance technique. The selective formation of large colloidal assemblies (Figure 1b) of complementary nanoparticles is demonstrated by transmission electronic microscopy (Figure 1c) and finally characterized by fluorescence spectroscopy. These results open the route to the design of hybrid colloidal assemblies with original optical response.

References

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Figures

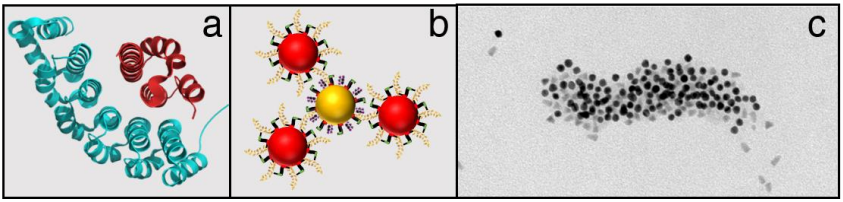

Figure 1: (a) The structure of the pair of artificial α-Repeat proteins used in this work. (b) Schematic representation of the hybrid self-assembly between gold nanoparticles and quantum dots. (c) TEM image of the obtained hybrid nanostructures.