Supplementary Material (ESI) for Chemical Communications

Supporting Information

Fluorescence Properties of Gold Nanorods and Their Application for DNA Biosensing

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Instruments and DNA Materials

Electrochemical synthesis of short gold nanorods was performed with an EG&G potentiostat (Perkin-Elmer, formally EGG, Princeton Applied Research, model 6310). A ScanArray LITE slide scanner of Packard BioChip Technologies was used for fluorescence imaging. Transmission electron microscopy (TEM) studies were conducted using a JEOL 2000FX instrument operating at 120 eV accelerating voltage. Fluorescence spectra were measured with a Gilford Fluoro IV spectrofluorometer with PMT set at 800 V. The purification of samples was carried out by using an Eppendorf centrifuge (model 5810R) equipped with an F45-30-11 rotor. For TEM imaging, the samples were deposited on 150 mesh copper girds with a holey carbon film and allowed to air-dry. The oligonucleotides were purified by two-step reversed-phase HPLC with a C18 column, using acetonitrile/triethylamine acetate (TEAA) (pH 7.4). Finally, the synthesized oligonucleotides were characterized by matrix-assisted laser desorption ionization time-of-flight mass spectroscopy (MALDI-TOFMS). Calculated molecular ions were identical to those obtained experimentally.

Synthesis and purification of gold nanorods

Short gold nanorod seeds (aspect ratio, AR 2-3) were synthesized by the electrochemical procedure described by Chang et al,[1] except that the applied current was set at 4 mA, and the reaction time was 40 min. Following the synthesis, the solution was centrifuged at 5,000 rpm for 30 min, and then the supernatant was collected and re-centrifuged at 12,000 rpm for 20 min at 25 ºC. The collected precipitate was dispersed in 1.5 ml Milli-Q water, and then used as the growth seeds for the synthesis of long nanorods. Short nanorods (AR: 2-3) characterized by TEM and UV spectroscopy are shown in Figure S1. Short gold nanorods with different aspect ratios can be obtained by controlling the applied current and concentration ratio between surfactant and co-surfactant.

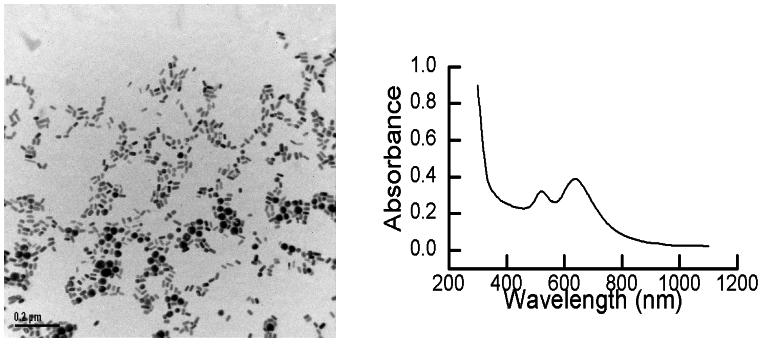

Fig. S1 TEM image (left) and UV- spectrum (right) of short gold nanorods synthesized by the electrochemical method.

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Middle length (30-120 nm) gold nanorods were prepared using the procedure of Nikoobakht and El-Sayed.[2] Except for the use of short nanorods for seeding (Fig S1), long nanorods (> 200 nm, AR >10) were prepared as described by Jana et al.[3] and Busbee et al.[4] The growth solution consists of 0.25 mM $[HAuCl_4].3H_2O$ and 0.1 M cationic surfactant cetyltrimethylammonuim (CTAB). 25 µl of 0.1 M ascorbic acid, and then 0.2 ml of the seed solution were added to 5 ml of the growth solution. After adjusting the solution pH to 3.2 by adding sodium hydroxide, the mixture was left for 8 h at 40 ºC. Then 0.5 ml of the resulting solution was transferred into 5 ml of the growth solution and incubated for 24 h at 40 ºC. The solution was centrifuged at 7,000 rpm for 10 min. The pink precipitate containing rods and large spheres was collected, re-dispersed in 0.1 M CTAB solution and centrifuged at 5,000 rpm for 20 min. Excess CTAB was removed and the collected precipitate was dispersed in Milli-Q water and re-centrifuged at 3,000 rpm for 30 min. Finally, the precipitate was redispersed in water and centrifuged at 12,000 rpm for 20 min. The procedure was repeated five times to remove most of the CTAB. The resulting gold nanorod solution was stable for over a month as verified by fluorescence measurement in agreement with the work of Dujardin et al. (*Chem. Commun. 2001, 14, 1264*).

In our experiments, the SH-DNA was immobilized on the rod surface through S-Au bond, such that the DNA should be perpendicularly positioned on the surface. In addition, the CTAB capping agent will prevent the backbone binding of Gs of DNA to the rod surface.

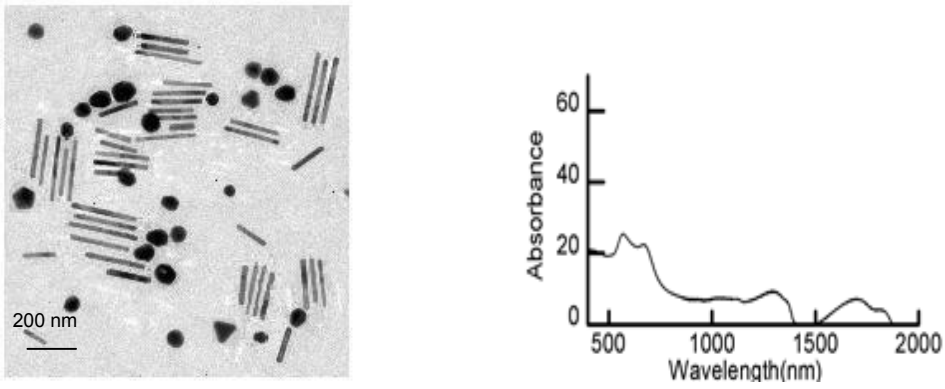

Fig.S2 TEM and UV-near IR spectrum of long gold nanorods after subtraction of the absorbance background of water at the near IR region.

References

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3. Jana, N.R.; Gearheart, L.; Murphy, C.J. *J. Phys. Chem. B* 2001, *105*, 4065.
4. Busbee, B.D.; Obare, S.O.; Murphy, C.J. *Adv. Mater.* 2003, *15*, 414.