Synthesis and application of highly sensitive fluorescent probes

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Introduction

Fluorescence probe plays a significant role in bioanalysis and biosensing. Traditional organic fluorescent dyes are widely applied duo to the stability and sensitivity. Recently, novel fluorescent nanomaterials also attract great attentions for merits of photostability, biocompatibility and selectivity. Based on the advantages and deficiencies of the fluorescent probes, we devote ourselves to synthesize plasmon-enhanced fluorescence (PEF) nanomaterials and aggregation-induced emission (AIE) molecules, thus improving the sensitivity and broadening the applications. .

Materials and Methods

The PEF nanomaterials with different cores of nanorods, nanobipyramids, nanoprisms, and nanocubes were synthesized. Then we achieved the largest fluorescence enhancement through the adjustment of the thickness of silica coating on the nanomaterials. Besides, a kind of the fluorescent molecules-based nucleotides were constructed to improve the methods of next generation sequencing.

Results and Discussion

To improve the sensitivity of fluorescent molecules, we studied the PEF effects of nanorods, nanobipyramids, nanoprisms, and nanocubes with different "hot spots" in aqueous solution, and achieved the largest enhancement of 10 fold. Then we applied them to the detection of pyrophosphate, microRNA, single nucleotide polymorphisms, and real-time monitoring of polymerase chain reaction products.[1,2] Besides, based on the PEF effect, we developed a single-molecule probe, which showed the single molecular message directly in biosensing and then we applied it to the imagining of intracellular telomerase in situ.[3] Moreover, given the requirement of environmentally friendly fluorescent probes, we developed a kind of DNA-templated fluorescent copper nanoparticles and designed a three-way junction DNA to differentiate single nucleotide polymorphism (SNP). Through the smart design, we realized the fast, simple and universal detection of SNP.[4] To improve the sensitivity and accuracy of next generation sequencing, we are studying the novel fluorescent-molecule-based sequencing methods. We synthesized the dye-based nucleotides, which possessed two emission wavelengths, thus we can improve the accuracy of sequencing through the simultaneous detection of two fluorescent signals.

Conclusion

The smart synthesis of different kinds of fluorescent probes successfully improved the sensitivity and broadened the applications. Now we are studying more novel fluorescent materials and making efforts to apply them to DNA sequencing and detection of the change of protein conformation.

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