About OMICS Group

OMICS Group International is an amalgamation of Open Access publications and worldwide international science conferences and events. Established in the year 2007 with the sole aim of making the information on Sciences and technology 'Open Access', OMICS Group publishes 400 online open access scholarly journals in all aspects of Science, Engineering, Management and Technology journals. OMICS Group has been instrumental in taking the knowledge on Science & technology to the doorsteps of ordinary men and women. Research Scholars, Students, Libraries, Educational Institutions, Research centers and the industry are main stakeholders that benefitted greatly from this knowledge dissemination. OMICS Group also organizes 300 International conferences annually across the globe, where knowledge transfer takes place through debates, round table discussions, poster presentations, workshops, symposia and exhibitions.

About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.

Bioanalytical Applications of Gold Nanoparticle Probs

Zhenxin Wang

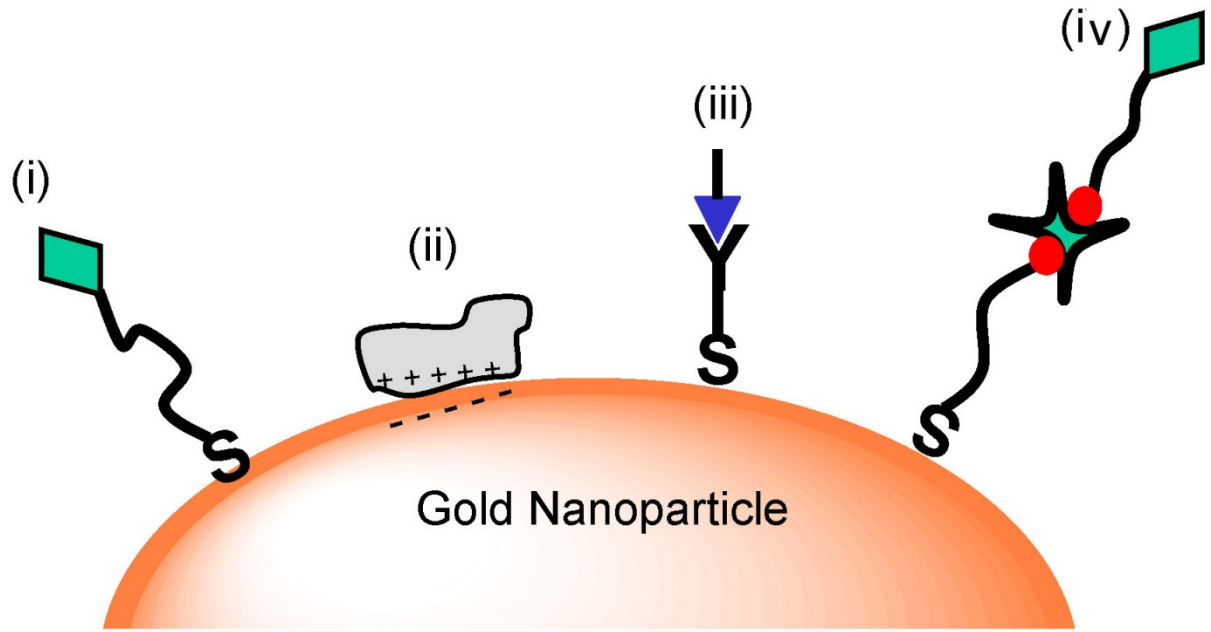
State Key Laboratory of Electroanalytical Chemistry, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022, China

2014.8

Outline

- Synthesis of gold nanoparticle probes
- Bioanalytical application of gold nanoparticle probes
- Conclusion

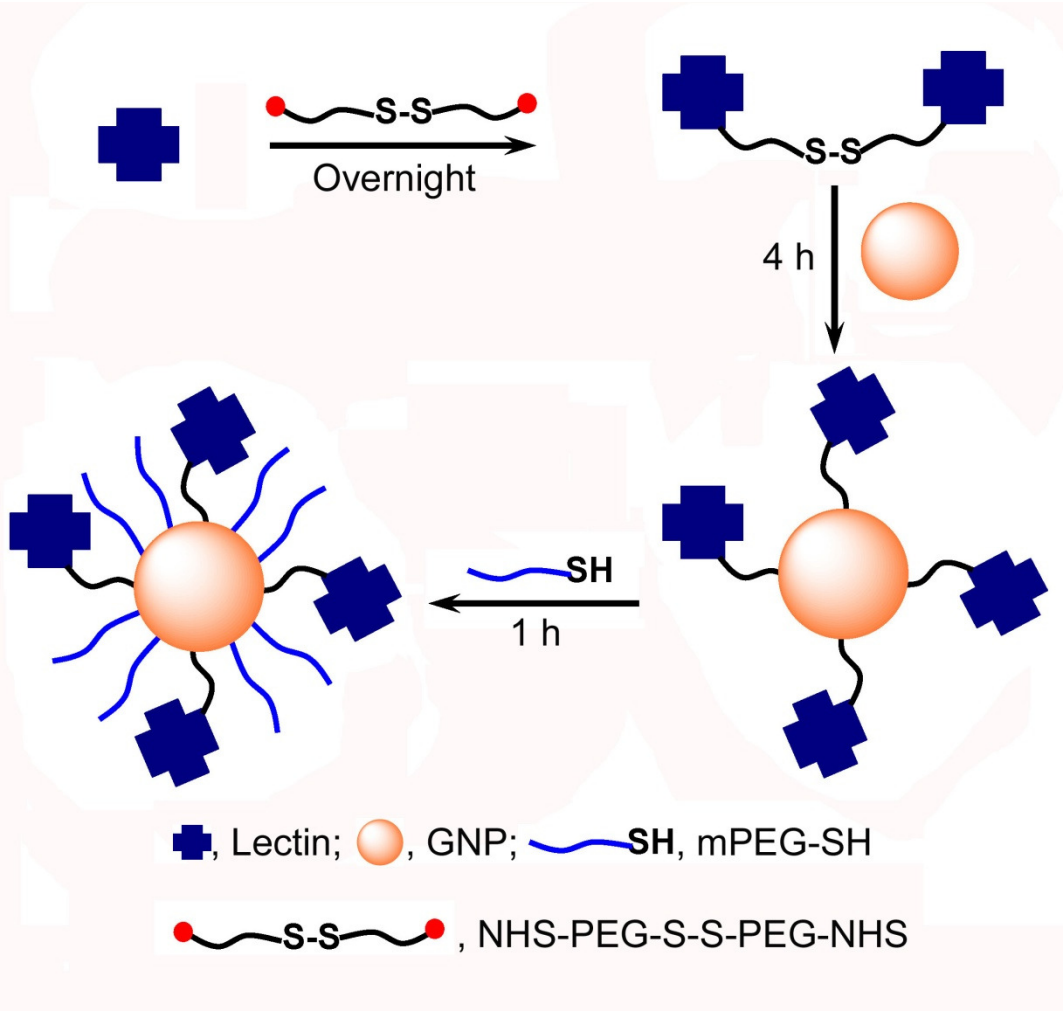
Synthesis of gold nanoparticle probes



(i): thiolated or disulfide modified ligands
(ii):Electrostatic interaction
(iii):antibody–antigen associations
(iv):streptavidin–biotin binding

Coord. Chem. Rev. 253 (**2009**) 1607

Synthesis of gold nanoparticle probes



Anal. Methods, 2011, 3, 1745–1751

Synthesis of gold nanoparticle probes

biotin-streptavidin as linkage

Synthesis of peptides (CALNN/CALNNGK(biotin)G) modified gold nanoparticles (Biotin-GNPs)

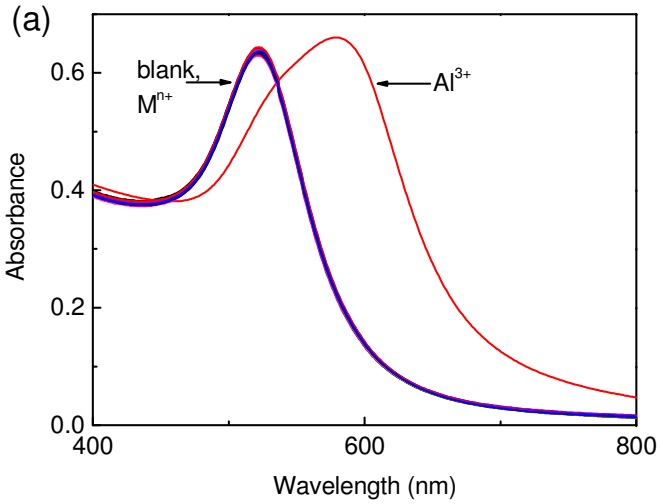
The streptavidin-GNPs were achieved by reacting Biotin-GNPs with streptavidin

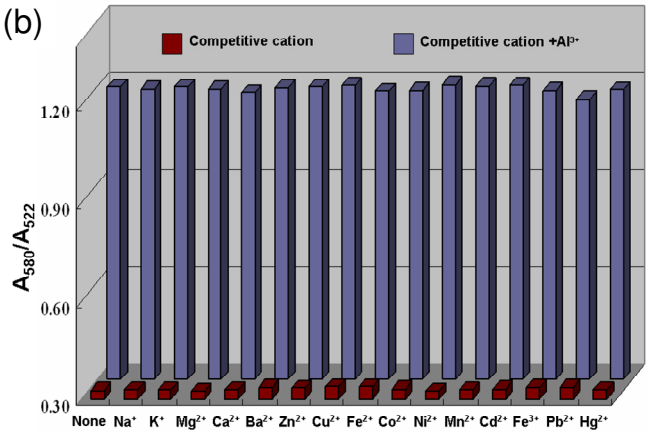
The F-A-GNPs were synthesised by reacting the streptavidin-GNPs with biotinylated biomolecules, i.e., peptide, lectin

Disadvantage：increasing hydrodynamic size

Anal. Biochem. 392 (**2009**) 77

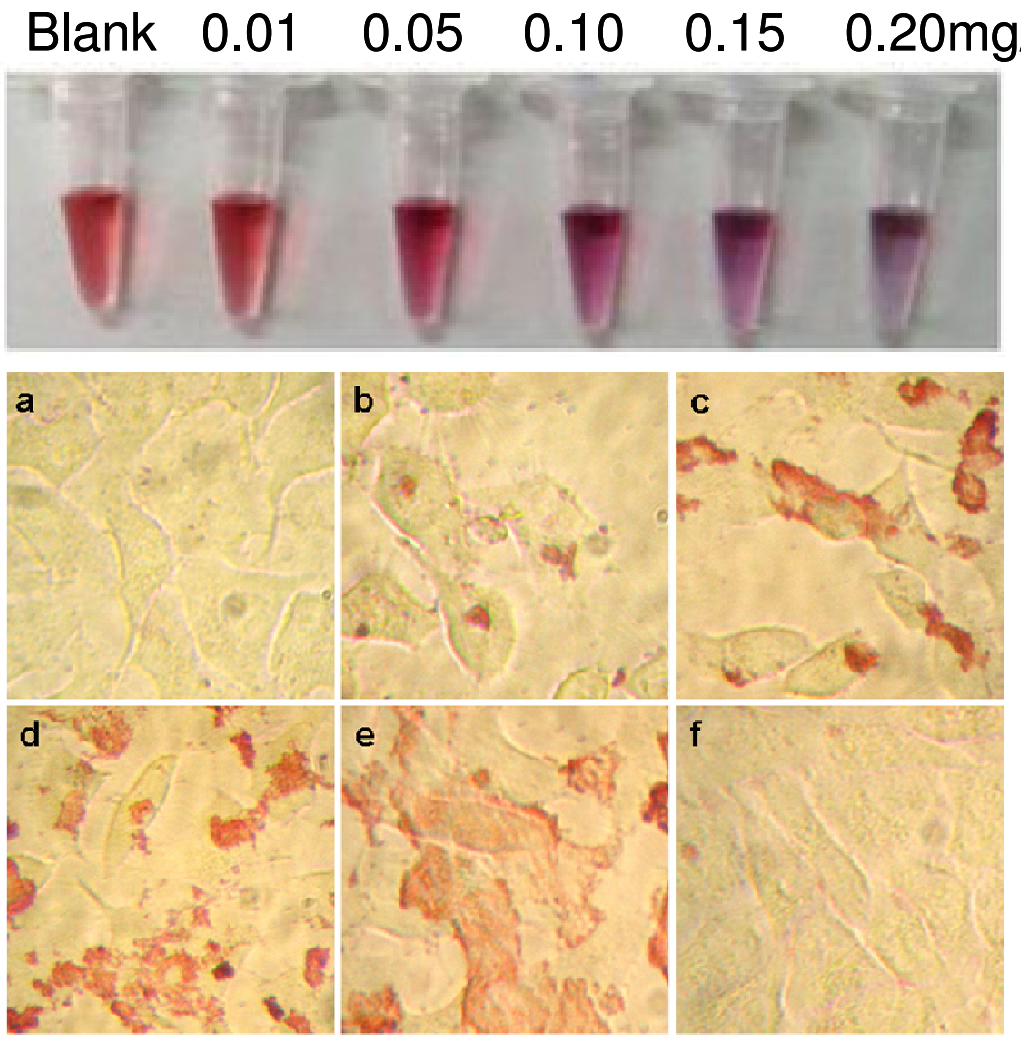
Application：ion detection





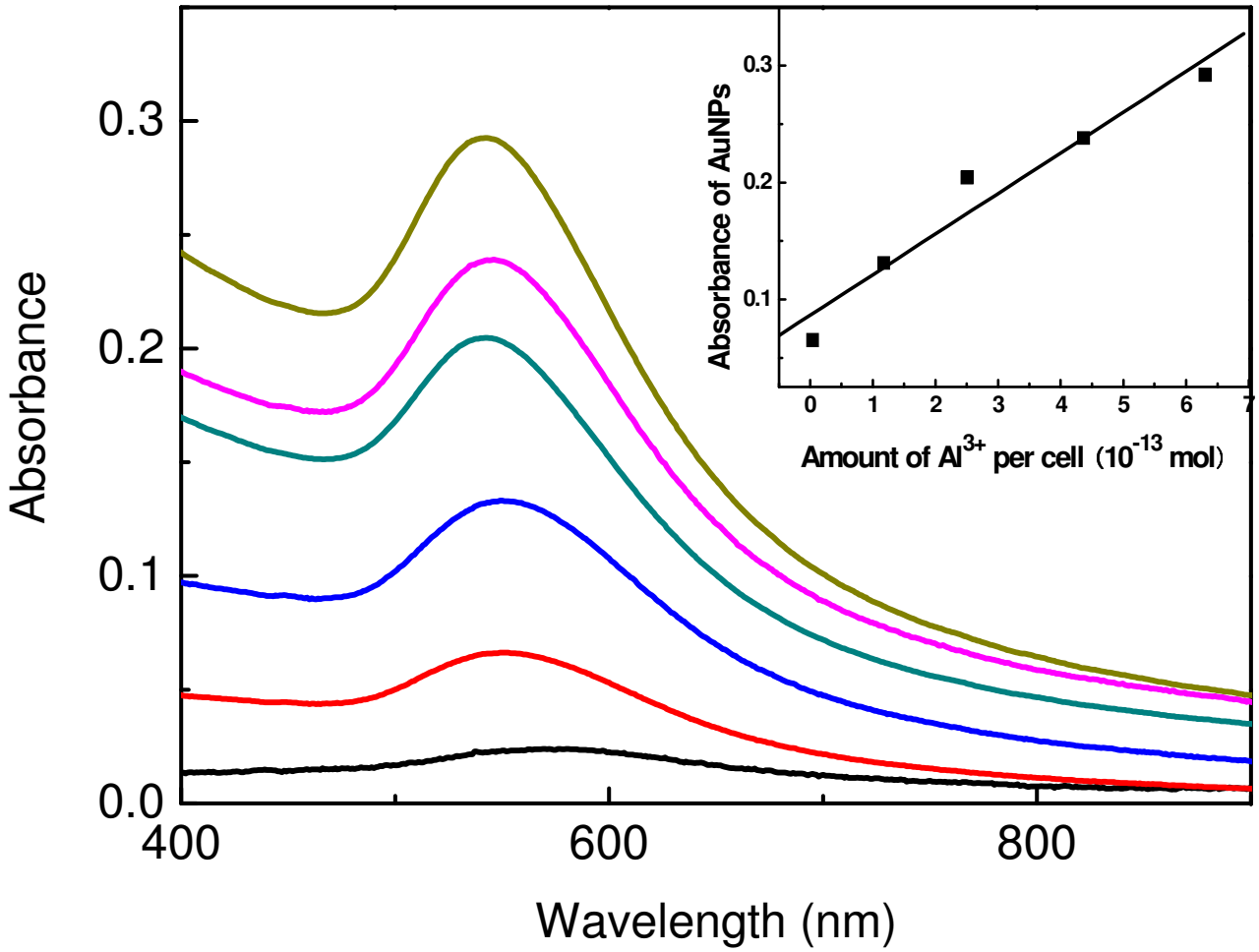
CALNN-GNP

0.2 μmol/L (7.4 μmol/L)



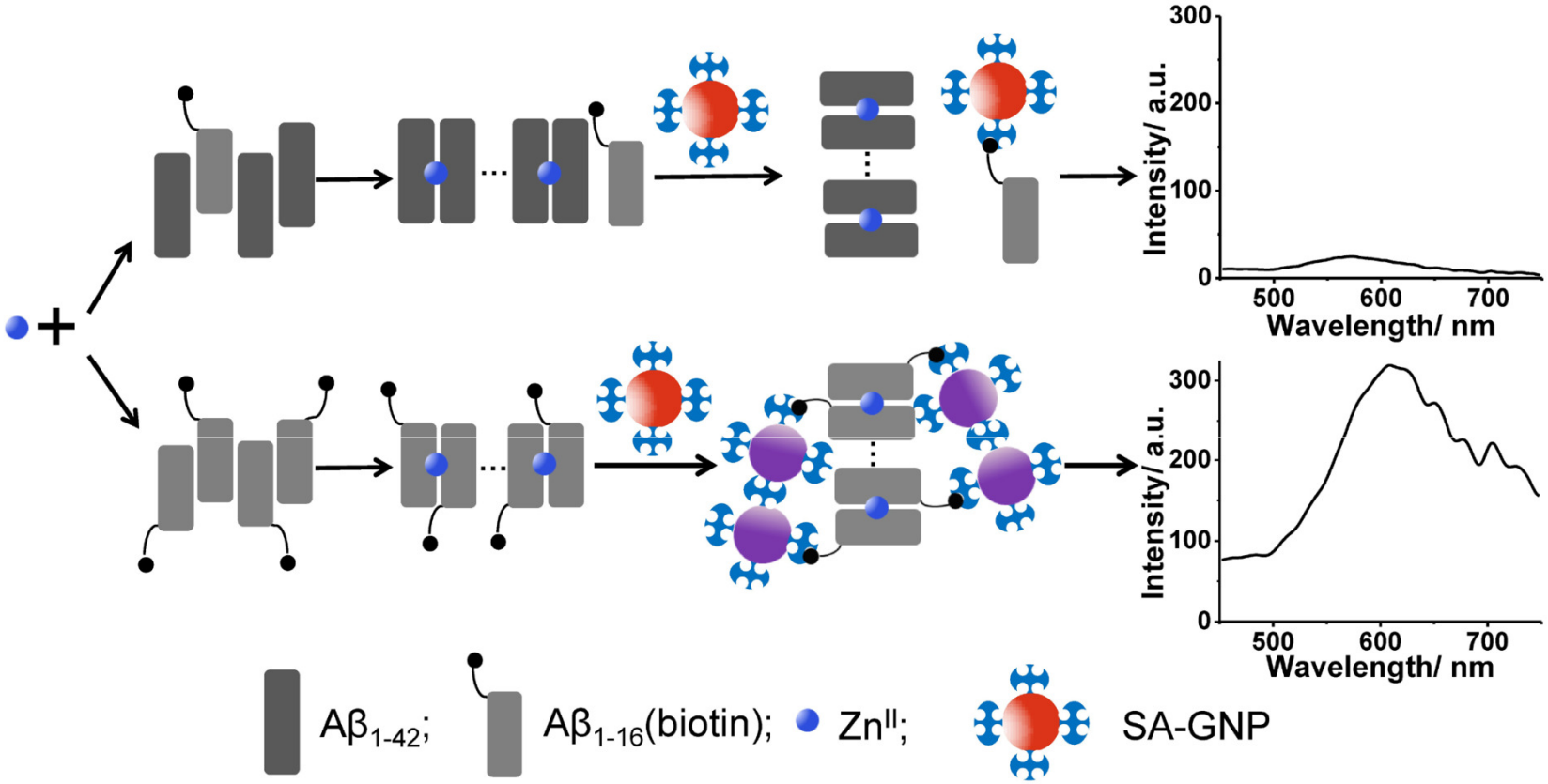
Chem. Commun., 46(**2010**)988; *Biosens & Bioelectr.*, 31 (**2012**)505

Application：ion detection



4.3×10^{-15} mol/cell， 4.3×10^{-15} to 6.3×10^{-13} mol/cell

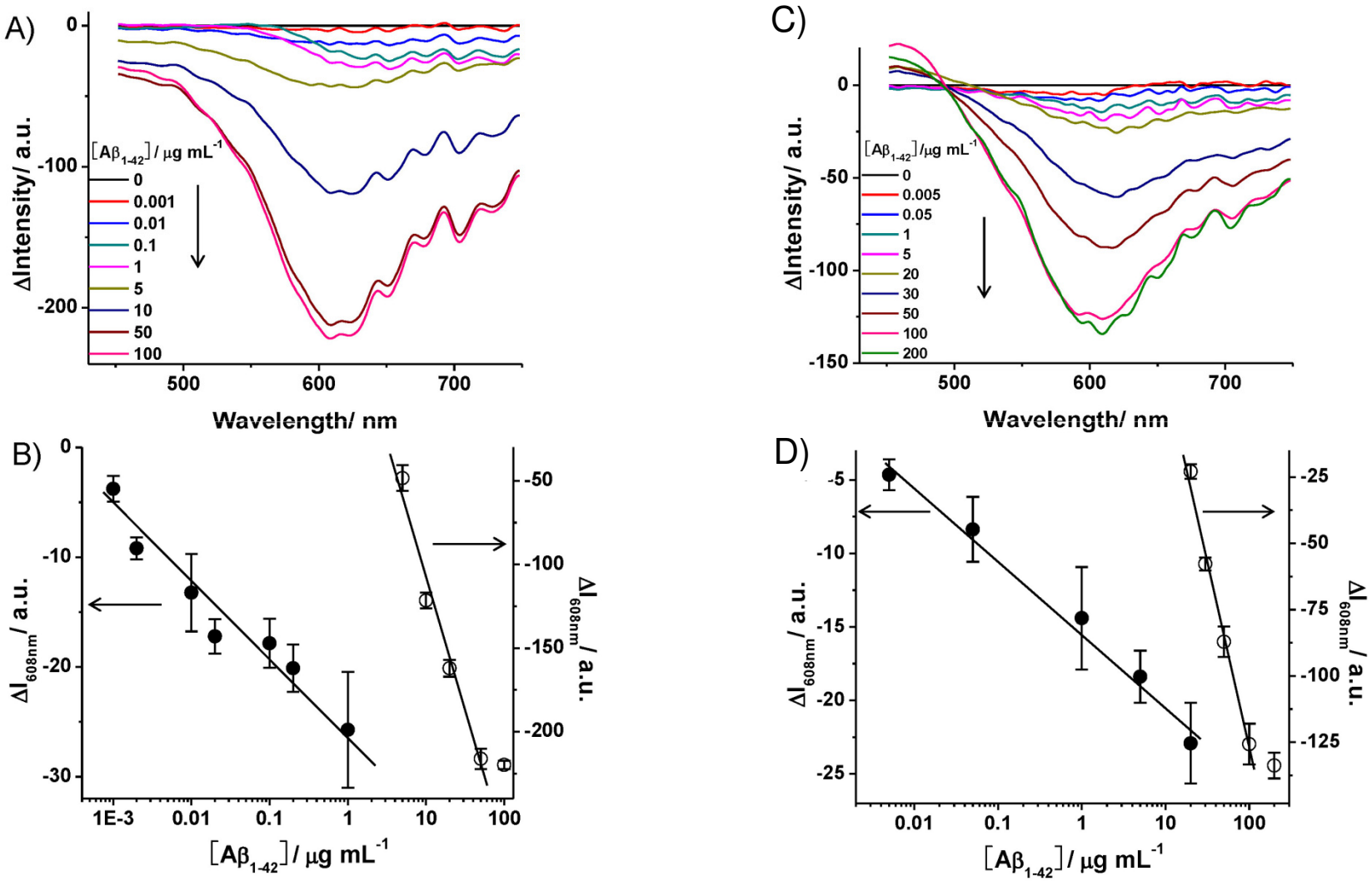
Application： $A\beta_{1-42}$ detection



Resonance light scattering (RLS) assay for detecting $A\beta_{1-42}$, the biomaker of Alzheimer's Disease (AD)

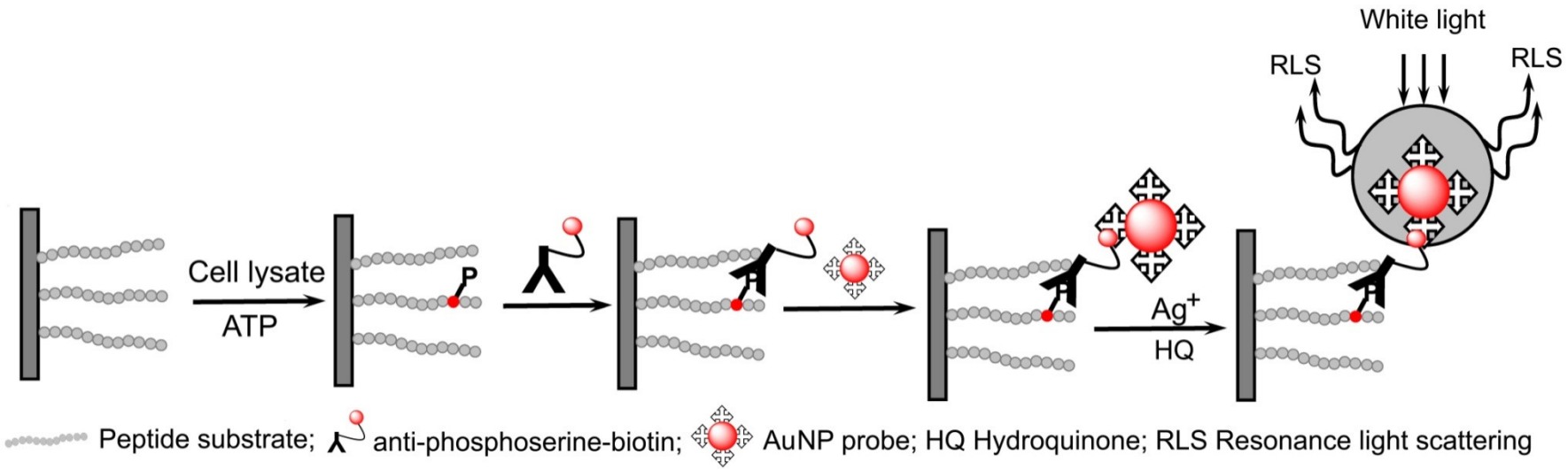
Chem. Commun., 47(**2011**) 9339; 48(**2012**), 8392

Application： $A\beta_{1-42}$ detection



A) and B) HEPES buffer; LOD 1 ng/mL. C) and D) 1% diluted HP LOD 5 ng/mL

Application：Microarray label

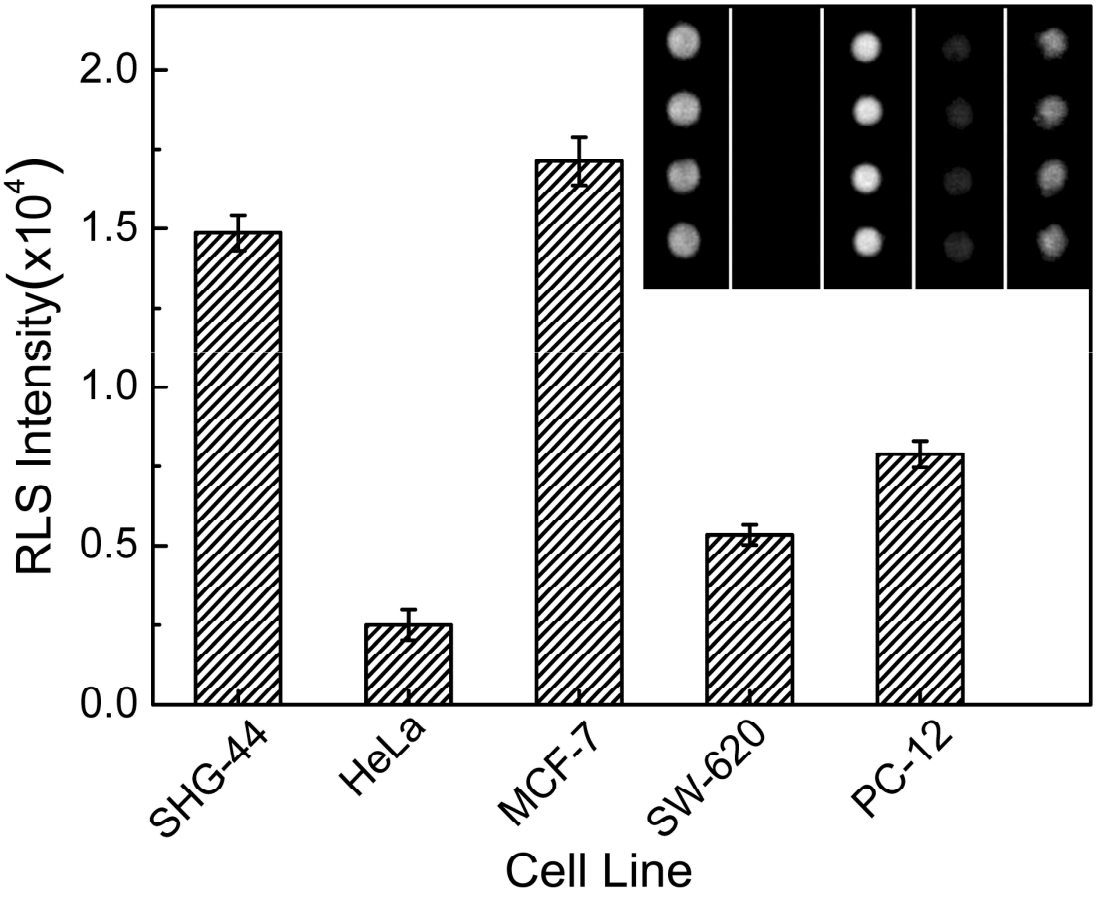


Non radio-active method with high sensitivity and selectivity

Anal. Chem., 79 (**2007**)773; 82 (**2010**)3067; 85(**2013**)7033;
Biosens & Bioelectr., 23 (**2008**)1125; 24(**2009**)3335.

Application：Microarray label

Cellular expression level of PKA



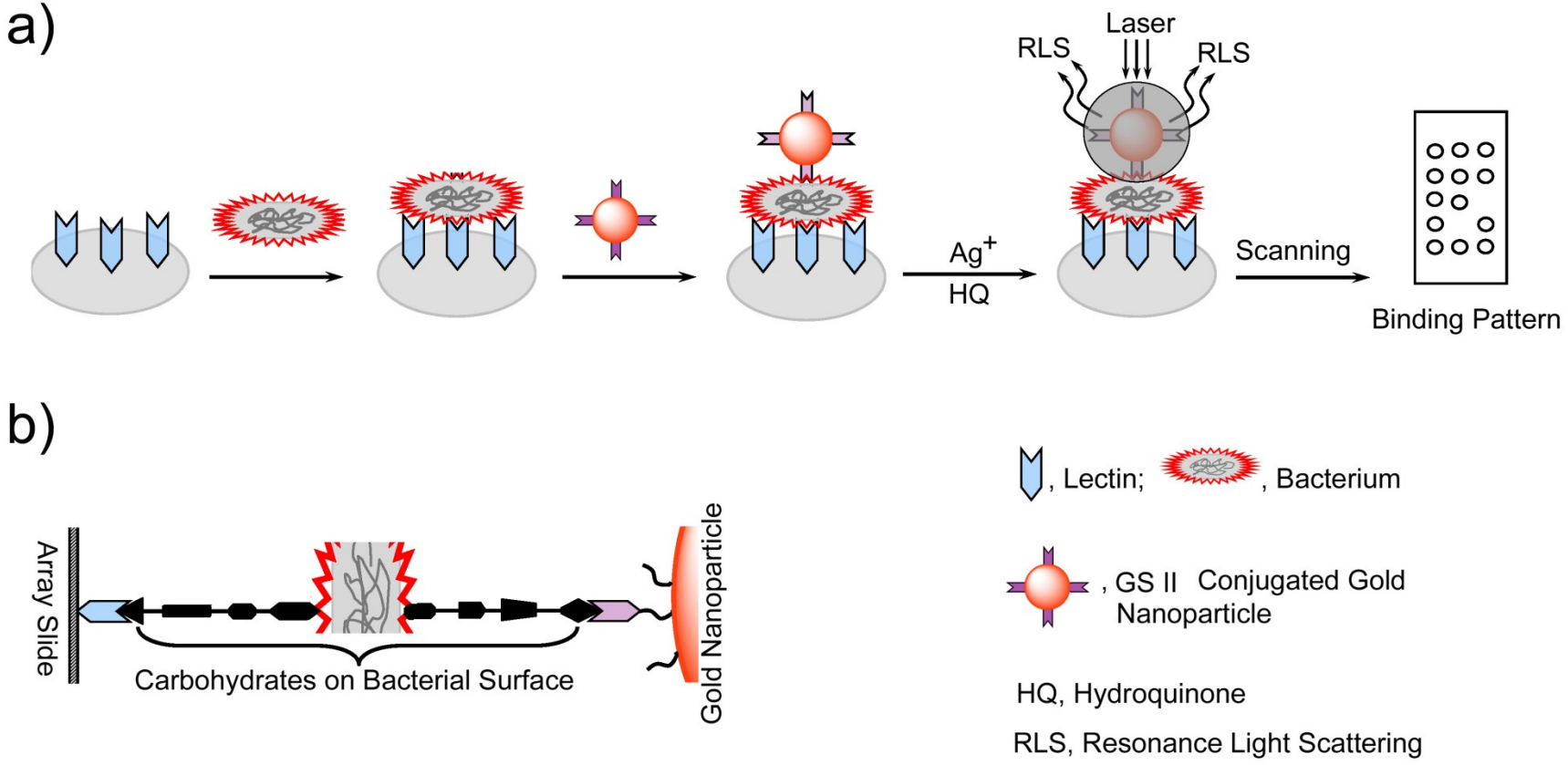
Application：Microarray label

Table 1 IC_{50} comparison and detection signal recovery

Inhibitors	Kinase	IC_{50}, SERS (μM)	IC_{50}, RLS (μM)	IC_{50}, fluorscence (μM)	IC_{50}, reported
C7	PKA	32	44	32	none
F9	PKA	0.27	0.429	0.495	0.570
H11	PKA	0.016	0.012	0.016	0.007
C7	LCK	2.4	1.7	3.2	none
C10	LCK	6.0	7.1	8.2	none
D4	LCK	4.4	4.4	6.0	none
D7	LCK	3.2	2.8	2.4	none
D8	LCK	0.022	0.022	0.026	0.050
F2	LCK	0.005	0.005	0.007	0.004
F10	LCK	0.056	0.090	0.122	0.088
G2	LCK	11	7.1	6.0	none
H10	LCK	0.14	0.168	0.142	0.131

Screening PKA and LCK inhibitors from the InhibitorSelect™ Protein Kinase Library I (80 compounds, MercK Co.).

Application：Microarray label

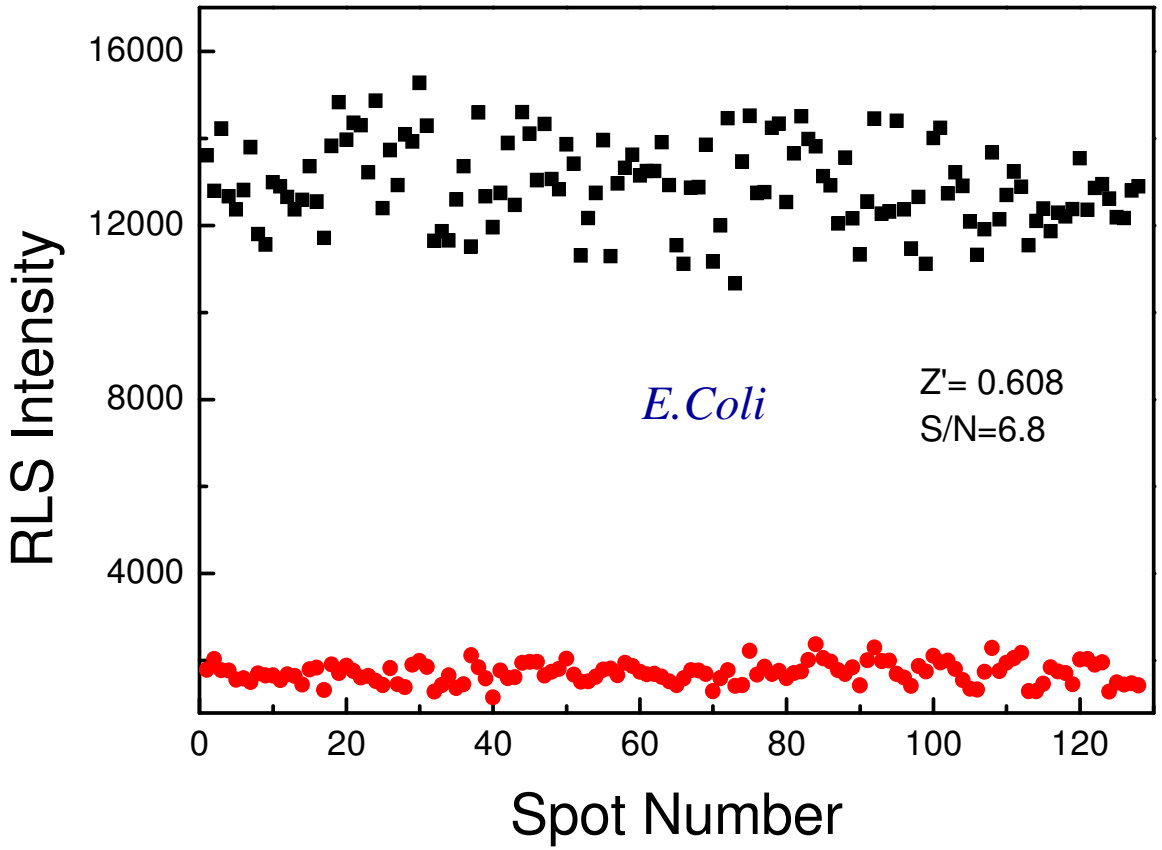


The interactions of 16 lectins with five bacteria: gram-negative (*E. coli* and *E. cloacae*), gram-postive (*B. subtilis* and *S. aureus*) and fungi (*S. cerevisiae*) have been studied.

Anal. Chem. 80(**2008**) 8822 ; 82 (**2010**) 9240; *Analyst*, 136 (**2011**) 4301.

Application：Microarray label

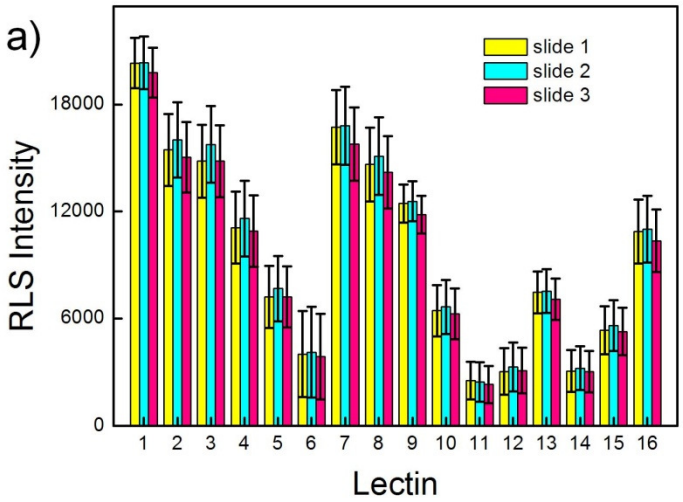
Performance of the microarray



After reaction with 5 microbes, reasonable assay performance (S/N> 3 and Z'> 0.5 (except *E. cloacae* assay (Z'= 0.477)

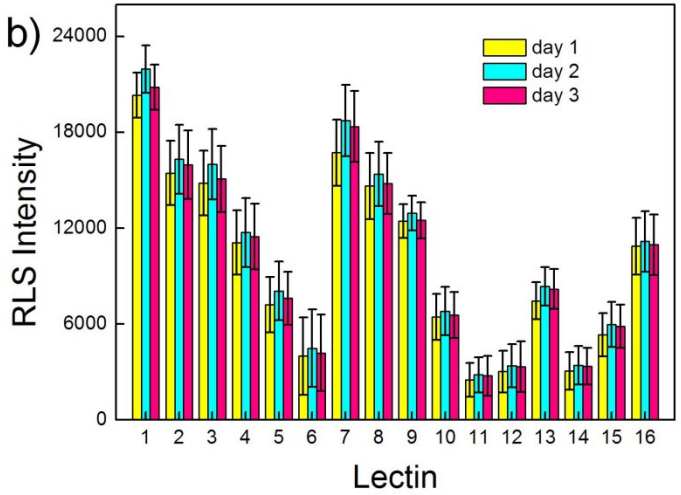
Application：Microarray label

Assay reproducibility



Lectin binding patterns of *E. coli*.

(a) 3 lectin microarray slides which printed at different batches at same day



(b) 3 lectin microarray slides which printed at different batches and different days

CV < 8.6 %.

Application：Microarray label

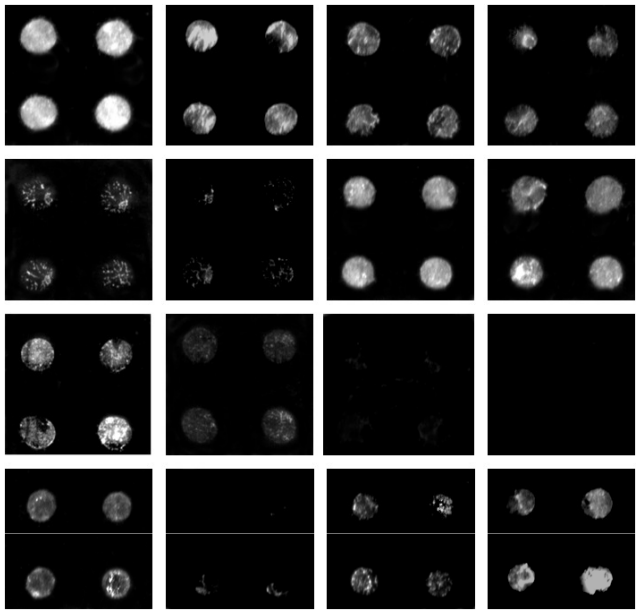
Assay Sensitivity

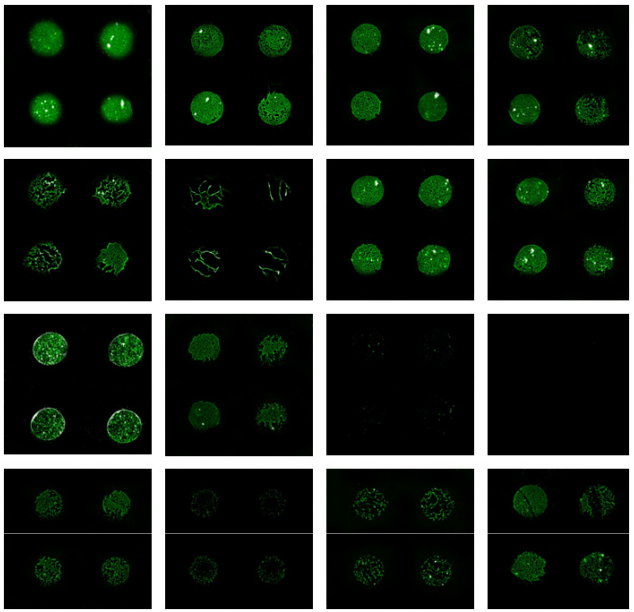
Table 2. The detection limits and dynamic ranges of the proposed assay

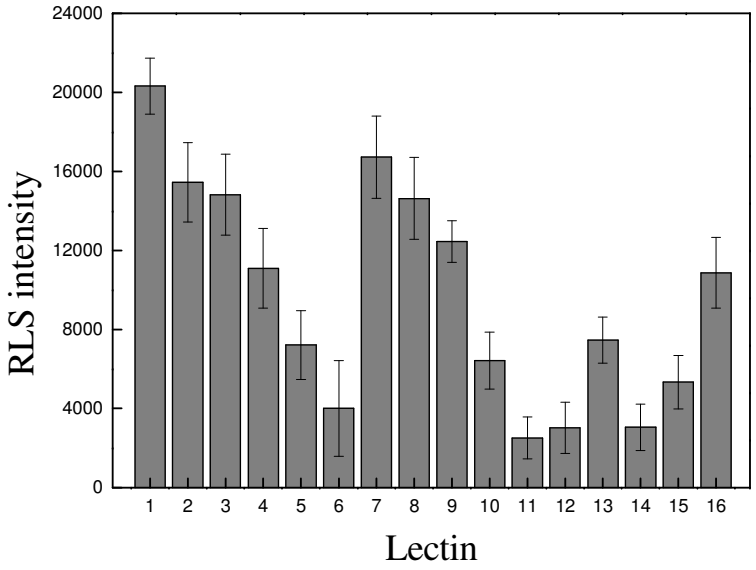
Analytes	Detection limit	Dynamic range
E. coli	10^5 cells/ml	10^5 - 10^8 cells/ml
E. cloacae	10^6 cells/ml	10^6 – 10^8 cells/ml
B. subtilis	10^5 cells/ml	10^5 – 10^8 cells/ml
S. aureus	10^5 cells/ml	10^5 – 10^8 cells/ml
S. cerevisiae	10^6 cells/ml	10^6 – 10^8 cells/ml

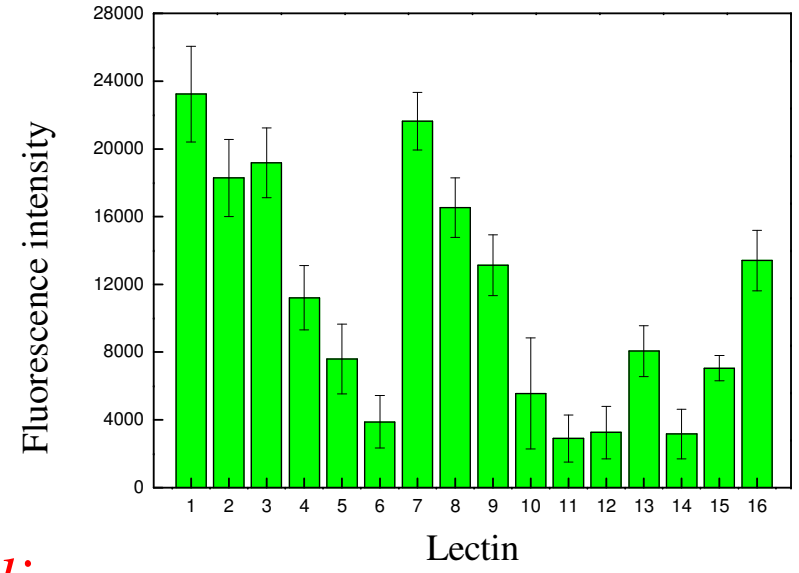
10 μL solution/asay: 10^3 cells

Binding pattern



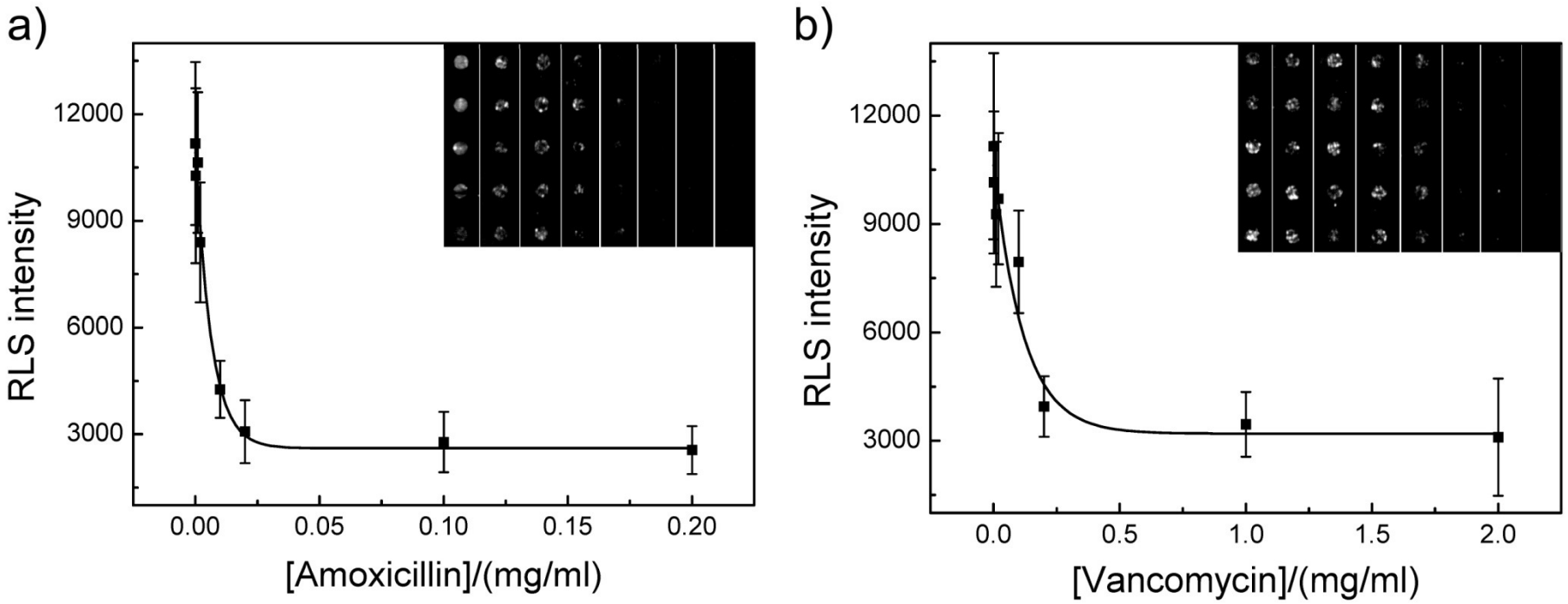






E.coli.

Application：Microarray label



E. Coli

Studying the interaction of antibacterial drugs with bacterial strains and deriving MIC (minimum inhibitory concentration)

Application：Microarray label

The MIC values of the bacteria against both vancomycin and amoxicillin (μg/ml)

	E. coli	*B. subtilis*	*P. fluorescens*
vancomycin[a]	**140**	**1.2**	**>500**
	(>128)[c]	**(0.25-2.0)[c]**	**(resistance)[c]**
Amoxicillin[b]	**12**	**0.2**	**>500**
	(2.5)[c]	**(0.5)[c]**	**(resistance)[c]**

[a] The MIC of amoxicillin and vancomycin are determined by the given dose-response curve. [b]The concentration of spotted IgG is 1 mg/ml in the spotting solution and the concentration of bacterial strains is 10^5 cells/ml in the initial culture solution, respectively. [c]Literature-reported values. [40,41]

Conclusion

1. A series of functionalized GNP probes have been prepared, which can be employed as probes/labels for developing microarray-based assays and colorimetric assays.
2. We have demonstrated that these assays can be used to (i) detect metal ions (e.g., Al^{3+}) and biomaker (e.g., $A\beta_{1\text{-}42}$) both in aqueous solution and practical samples, (ii) identify cellular expression levels and inhibitors of kinases, (iii) determinate binding affinity of lectin with glycans and bacteria/cells, and (iv) study the interactions of antibiotics with bacteria.

Acknowledgements

NSFC

CAS



电分析化学国家重点实验室

Professor Dianjun Liu

Dr Xiaokun Li

Dr Tao Li

Dr Jingqing Gao

Dr Jine Wang

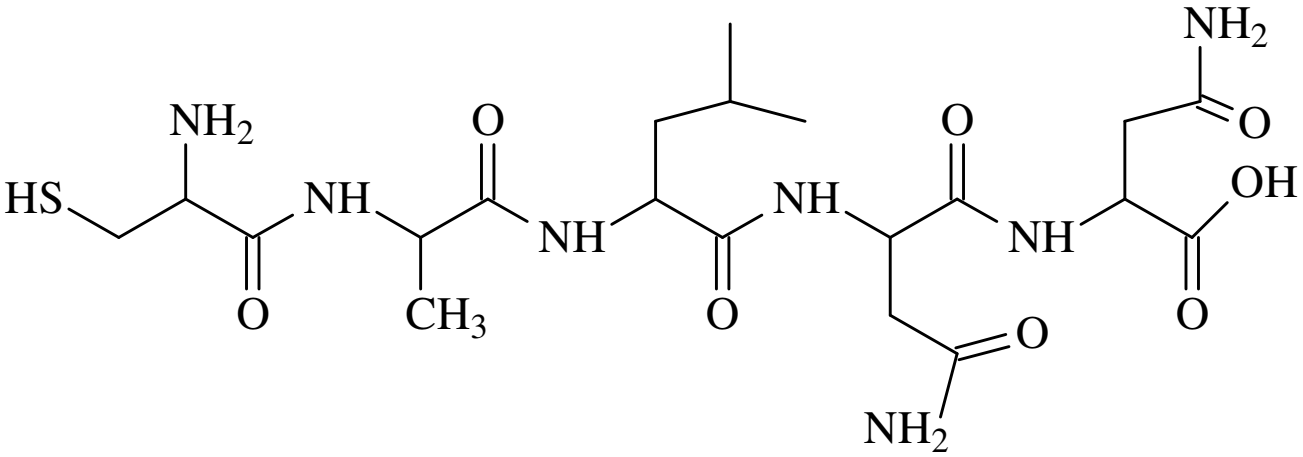
Dr Chengke Wang

Xiaomei Li

Lan Ma

Thank you for your time!

Synthesis of gold nanoparticle probes



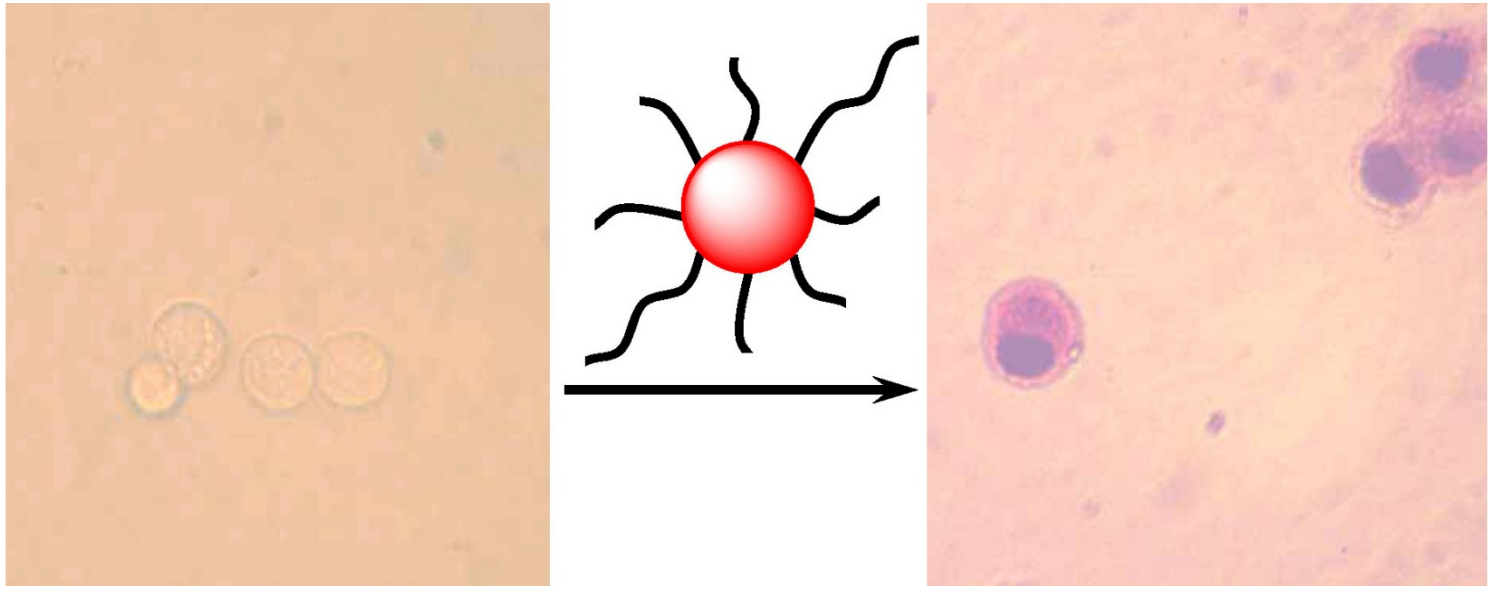
Synthesis of novel multifunctional peptide (CALNN/CALNN-X) nanoparticles

i. e. X=DNA, Biotin, Peptide, Protein.

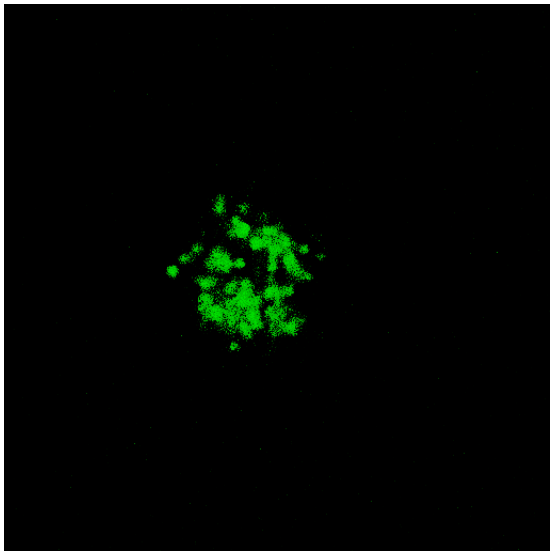
(1), Extremely stable; (2), stabilisation and bio-functionalisation have been achieved in a single preparative step starting with citrate stabilised gold hydrosols and a derivatisation cocktail of peptide capping ligands; (3) easily control the number of functional groups on particle surface.

Levy, *et al, JACS,* 126(**2004**)10076*; Bioconjugate Chem*, 16(**2005**) 497; *ChemBioChem*, 7(**2006**)592

Application： cellular delivery agents



CALNN/CALNN-F/CALNNR$_8$-GNP



Langmuir, 24(**2008**)10293; *Nanoscale*, 2 (**2010**)269.