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Comparison of nanosized labels and detection techniques in the lateral flow immunoassay of antibiotic lincomycin

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Contents

- Lateral Flow Immunoassay;
- Approaches to improve the sensitivity of immunoassay;
- Antibiotics of lincosamide group;
- Conventional methods for lincosamide detection;
- Development and comparison of three formats of lateral flow immunoassay for detection of model analyte, lincomycin;
- Conclusions

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Lateral Flow Immunoassay (LFIA)

Production of test-systems

1. Obtaining of the immunoreagents

2. Appling of the components on the membranes

3. Assembling of a multimembrane composite and cutting it to individual test strips

- ❑ All reactants are applied onto membranes before the assay;
- ❑ Contact of sample and test-strip initiates all further processes;
- ❑ The assay can be carried out without any additional reactants and manipulations;
- ❑ The assay results may be estimated visually without any additional equipment.

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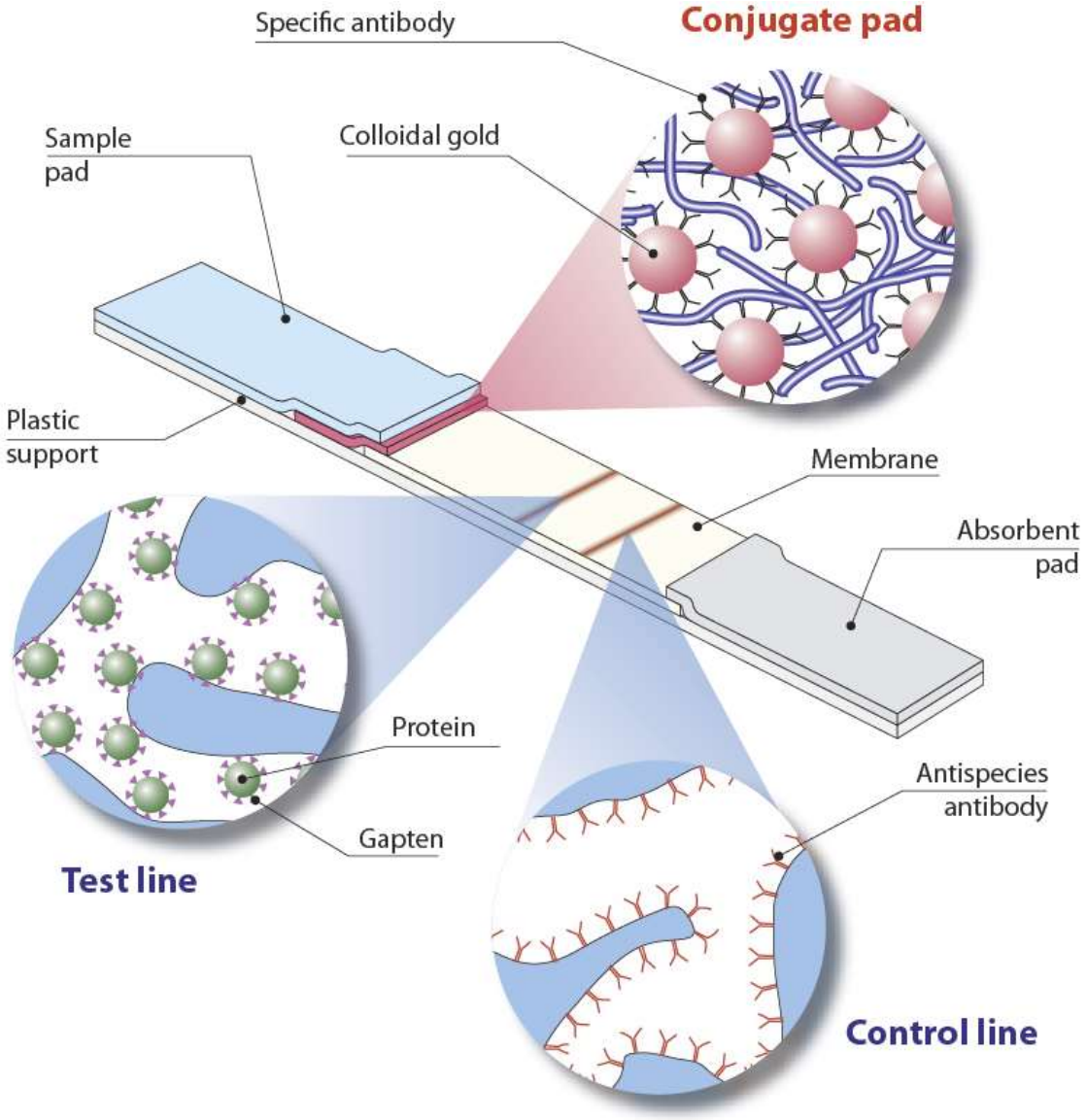
Test strip composition and the assay principle



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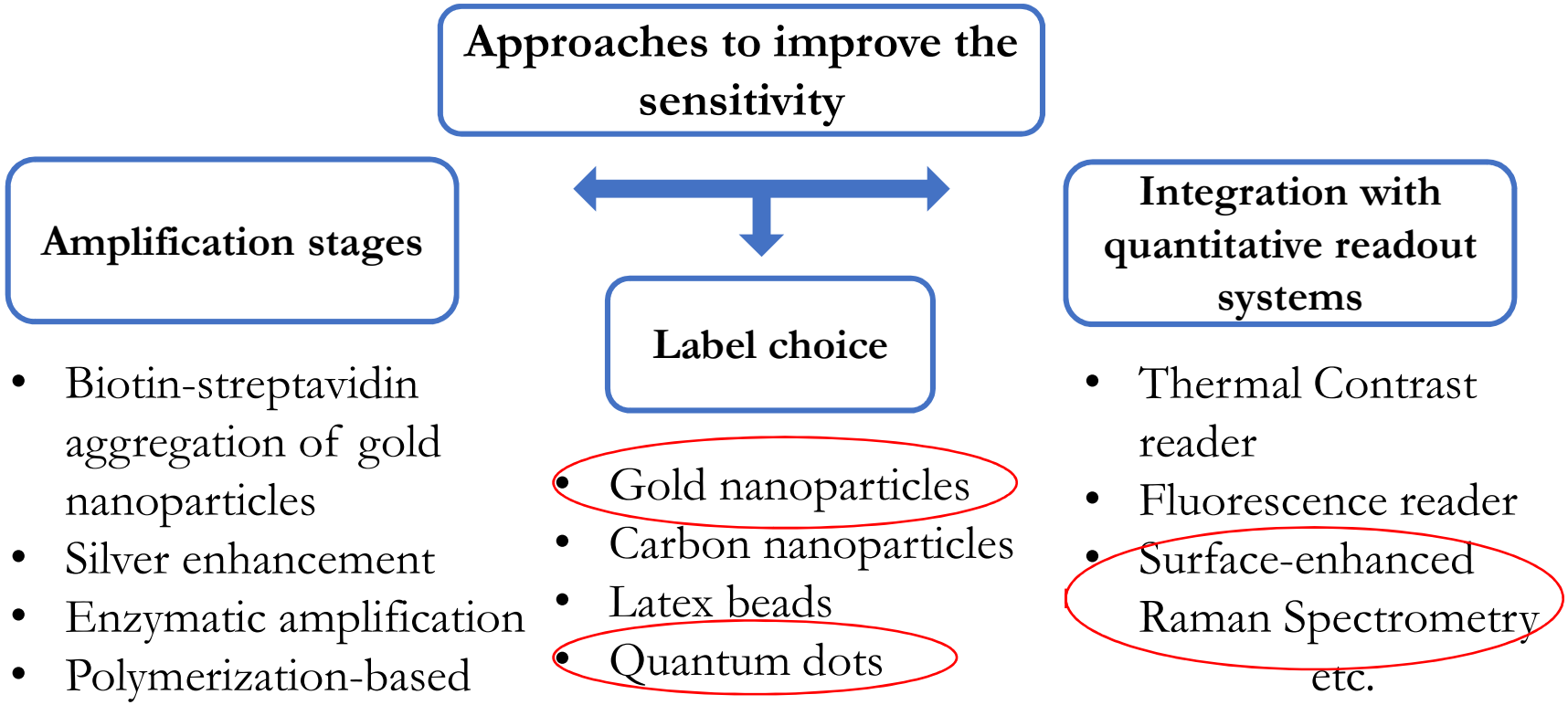
LFIA: Approaches to improve the sensitivity of assay



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Antibiotics of lincosamide group: adverse effects

Lincosamides

Prophylaxis

Therapy

Transit through the food chain and the accumulation of residual quantities of antimicrobial agents

Potential risk to human health: formation of antibiotic-resistant strains of pathogens, development of various pathological effects – allergic reactions, gastrointestinal tract diseases, kidney failure, candidosis, etc.

Control of residual quantities of Lincosamides in foodstuffs

Development of simple, rapid and cheap methods for Lincosamides detection

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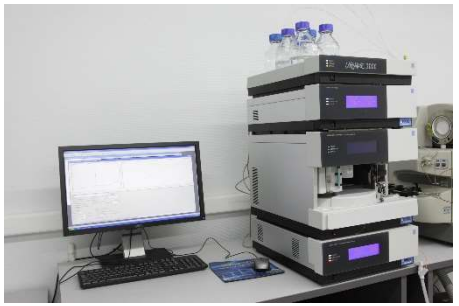
Conventional methods of lincomycin detection

- **Microbiological methods**

"+" methodological simplicity;

"–" low specific, time-consuming (2-3 days).

- **Instrumental analytical methods including LC-MS and HPLC**



"+" highly specific and sensitive;

"–" require expensive equipment, large volumes of solvents, highly qualified personnel, long and complex procedures of food samples preparation before analysis.

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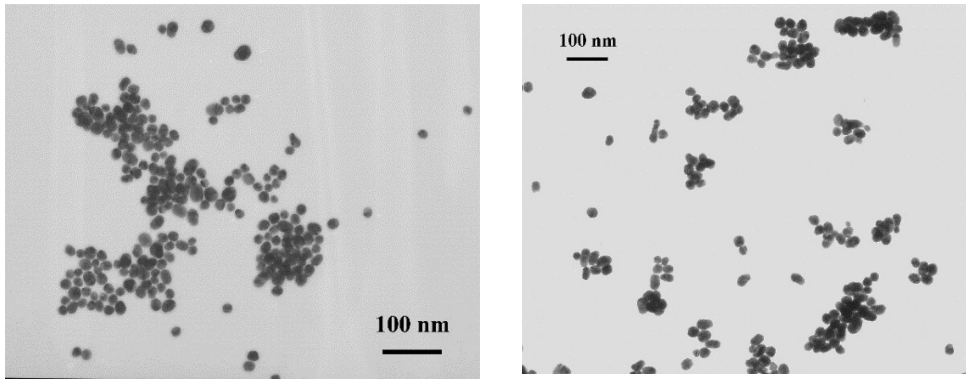
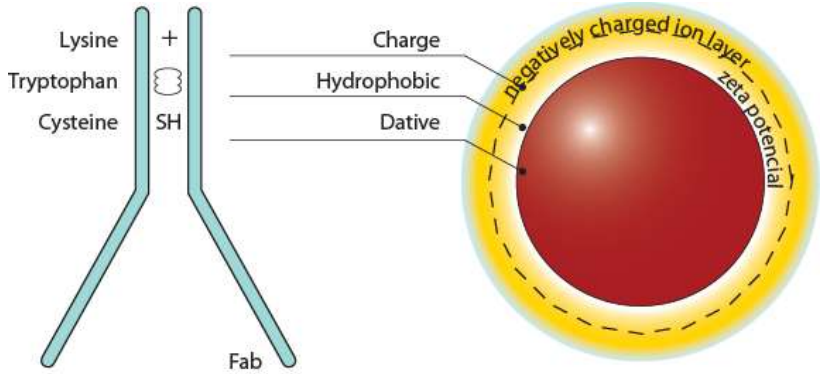
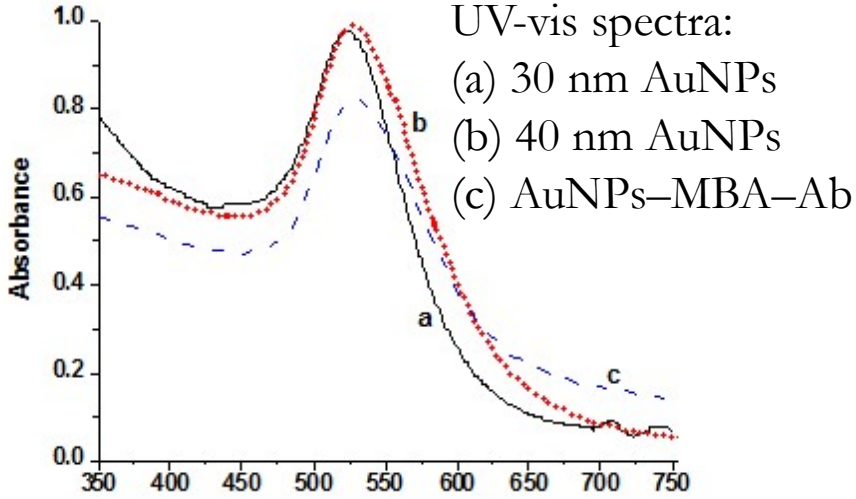
Preparation of gold nanoparticles (AuNPs) and their conjugates with antibodies

$$HAuCl_4 + e^- = Au^0$$

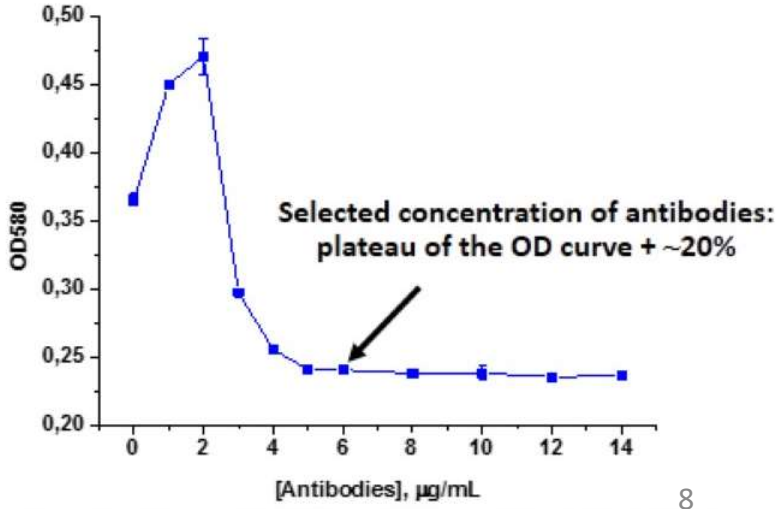
The electron micrographs of AuNPs







UV-vis spectra:
(a) 30 nm AuNPs
(b) 40 nm AuNPs
(c) AuNPs–MBA–Ab



Flocculation curves for anti-lincomycin antibodies

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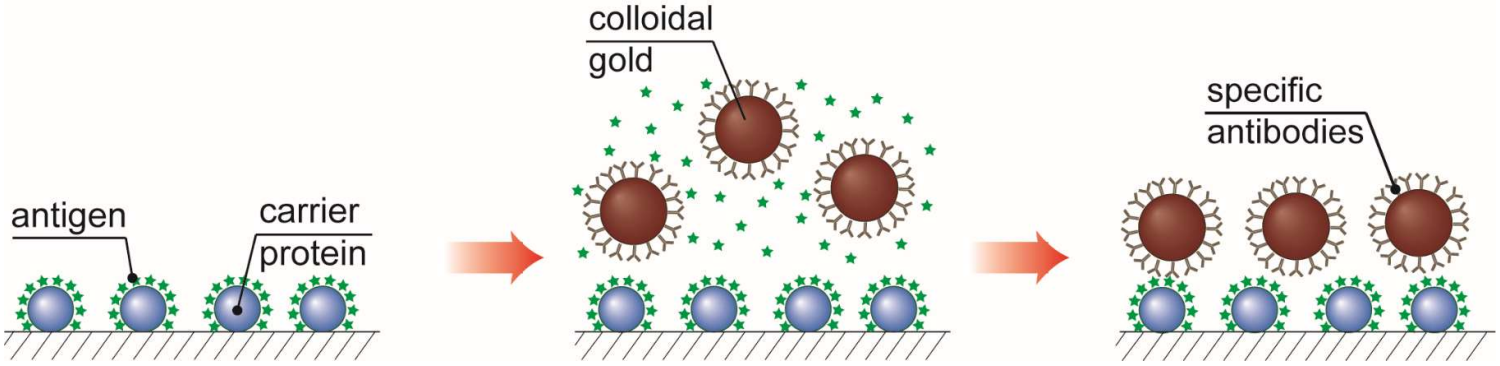
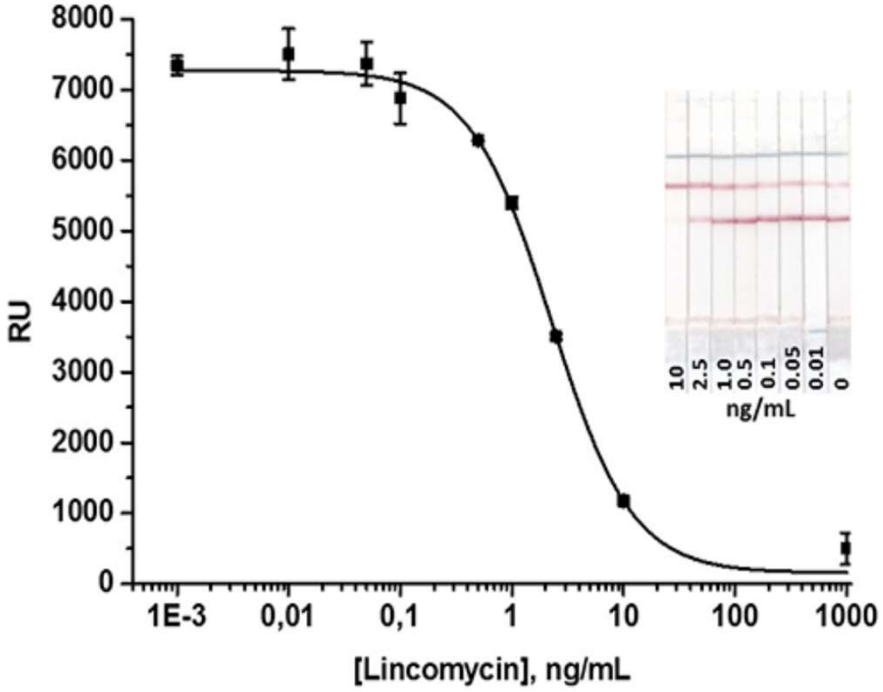
Conventional AuNP-based LFIA of lincomycin (direct competitive format)

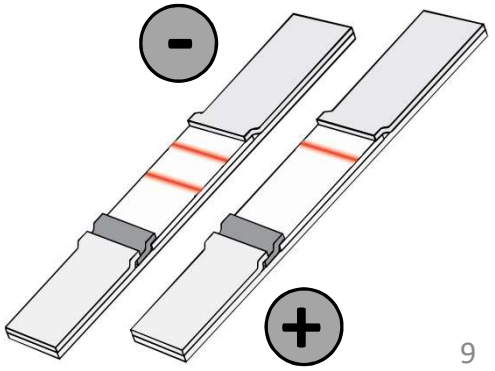




Instrumental detection limit – 0.4 ng/mL

Visual detection limit – 10 ng/mL

Assay duration – 15 min



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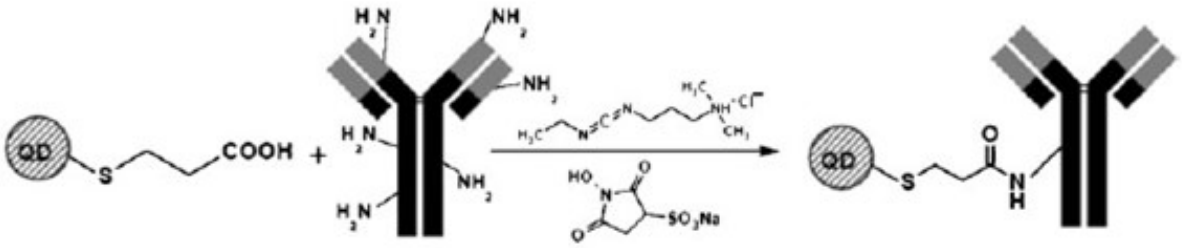
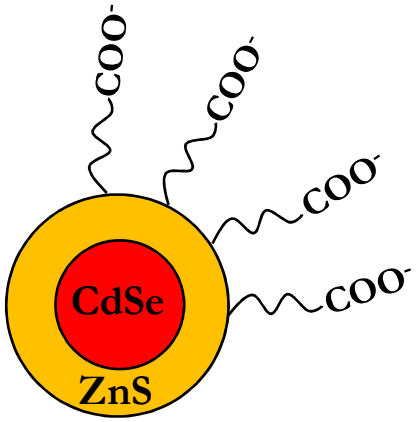
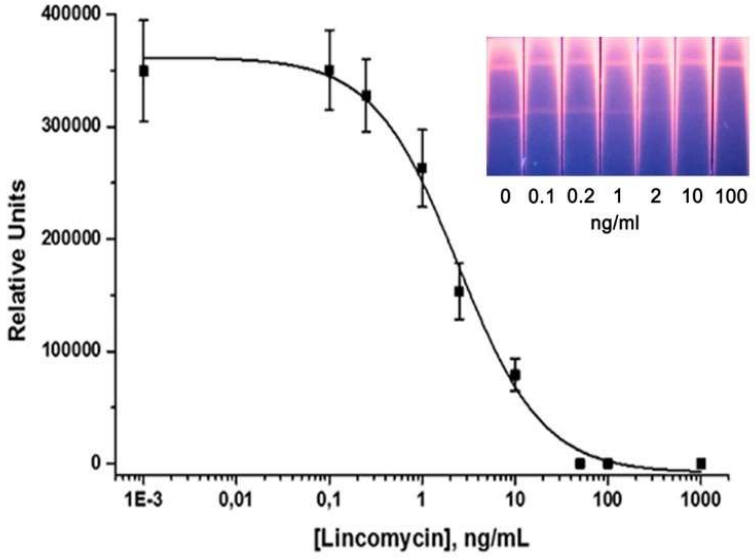
Fluorescent QD-based LFIA







Water soluble core/shell quantum dots with reactive group of carboxylic acid

Instrumental detection limit – 0.2 ng/mL

Visual detection limit – 20 ng/mL

Assay duration – 15 min

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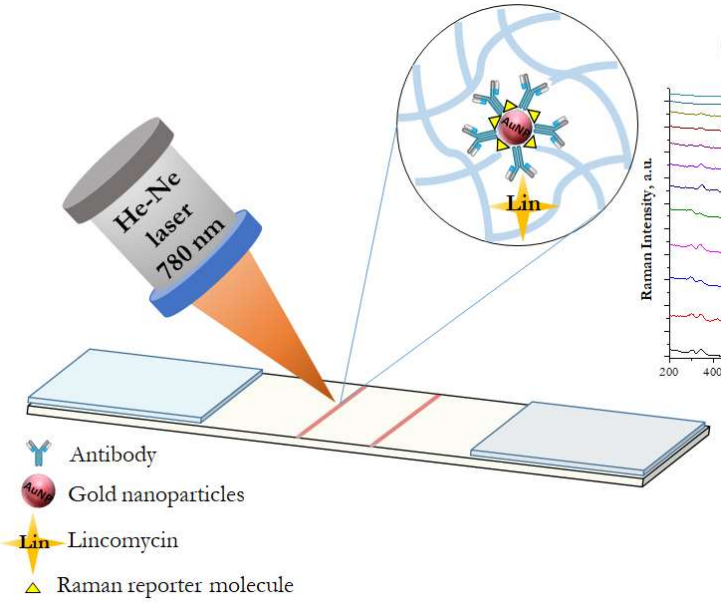
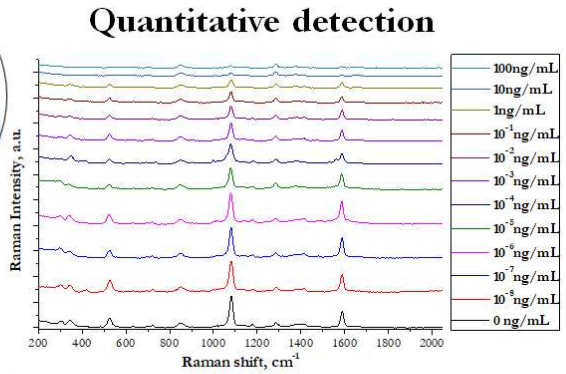
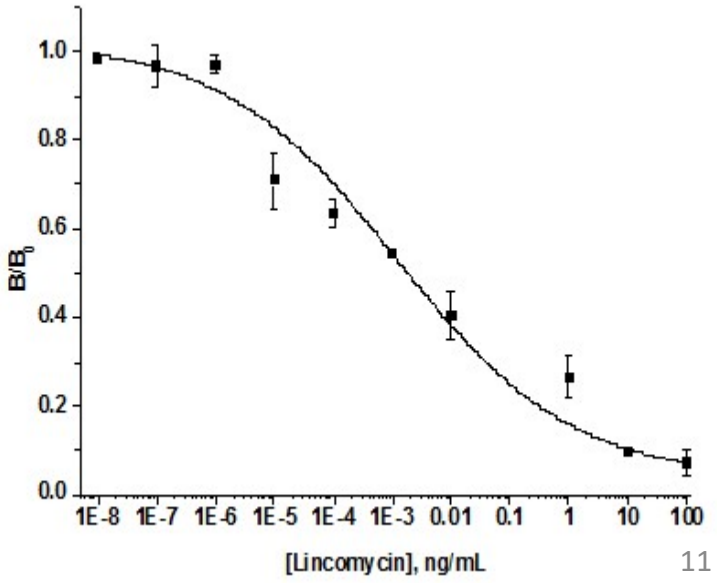
AuNP-based LFIA integrated with Surface-enhanced Raman scattering readout technique







Instrumental detection limit – 1.4 fg/mL

Visual detection limit – 10 ng/mL

Conclusion

- In this study, three approaches of immunoassay including conventional AuNPs-based LFIA, fluorescent QD-based LFIA, and SERS-based LFIA for detection of model analyte, lincomycin, were performed and compared;
- The detection limits of the conventional AuNP-based-/ QD-based-/ SERS-based LFIAs are 0.4 $ng \cdot mL^{-1}$/ 0.2 $ng \cdot mL^{-1}$/1.4 $fg \cdot mL^{-1}$, correspondingly;
- Due to availability, the proposed SERS-based LFIA is a promising technique for the control of antibiotics of various classes as well as for a wide range of other low molecular weight compounds.

Acknowledgements

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Thanks for your attention