

# SIDE-BY-SIDE AND END-TO-END GOLD NANOROD ASSEMBLIES FOR ENVIRONMENTAL TOXIN SENSING

Kotov, N. A. *et al.*

Department of Chemical Engineering, Department of Biomedical Engineering,  
Department of Materials Science and Engineering, University of Michigan, USA

Angewandte  
International Edition Chemie *Early View*

DOI: 10.1002/anie.200907357

*Sreeprasad T. S.*

17-07-10



# *Introduction*

- ❖ Controllable assembly of nanoscale building blocks
- ❖ Collective behavior of nanocolloids
- ❖ Anisotropy of nanoscale interactions
  - ❖ stems from the shape of nanocolloids
  - ❖ unequal distribution of organic molecules on their surface
- ❖ Gold nanorods (Au NRs) have both geometrical and chemical anisotropy components
- ❖ Au NRs can be assembled by interactions with organic molecules, polymers, an antibody–antigen reaction, biotin–streptavidin connectors, and DNA.
- ❖ Excellent biosensors because of large changes in oscillation frequencies of plasmons when NR pairs are formed
- ❖ Sensing capabilities have been virtually unexplored
- ❖ A better understanding of methods having high speed/selectivity/sensitivity detection of common environmental pollutants is thus of great importance.





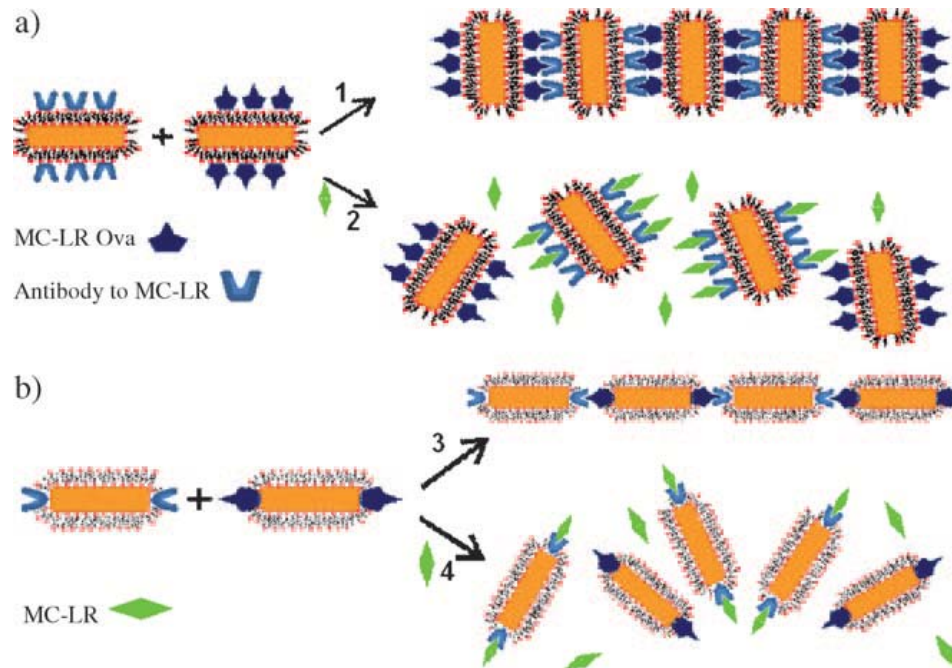
## **In this paper**

- ⊕ To explore the potential of NR assemblies taking a pervasive environmental toxin, namely microcystin-LR (MC-LR).
- ⊕ They successfully used Au NRs for detection of MC-LR, which is significantly more sensitive than the traditional techniques, such as ELISA, yielding detection limit of  $5 \text{ pgmL}^{-1}$ . It is also much simpler and faster than any other methods. The pattern of the assembly strongly affects the sensitivity parameters for MC-LR detection.

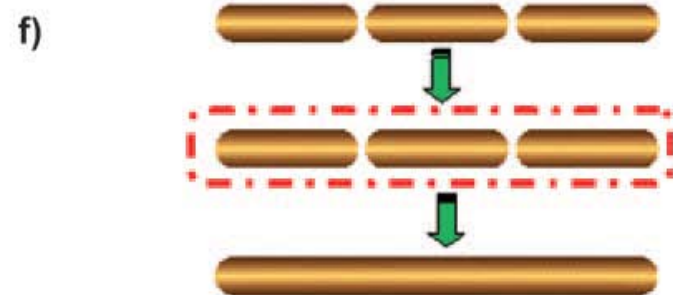
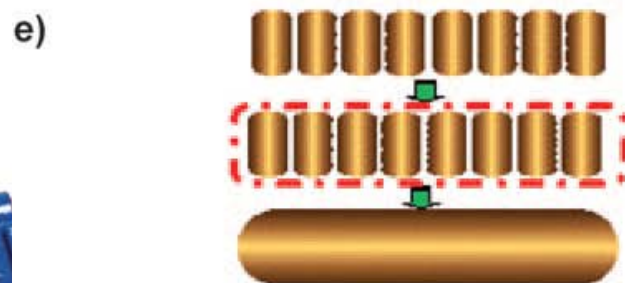
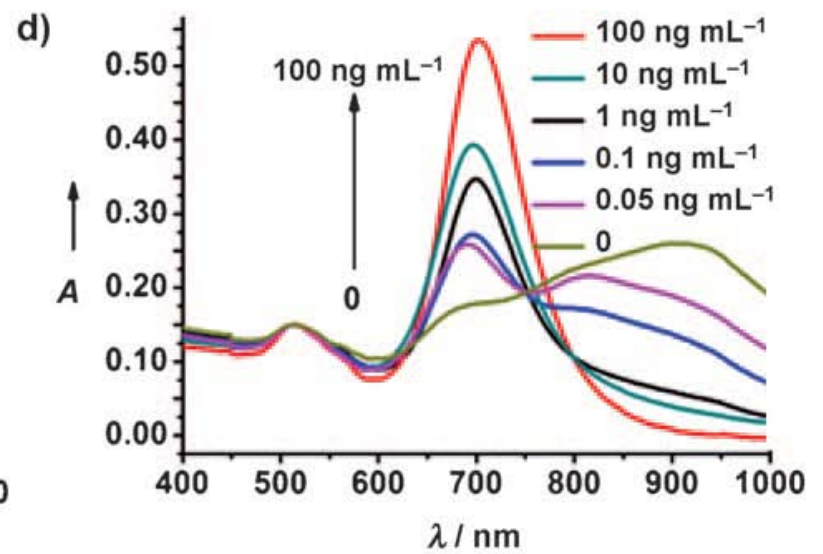
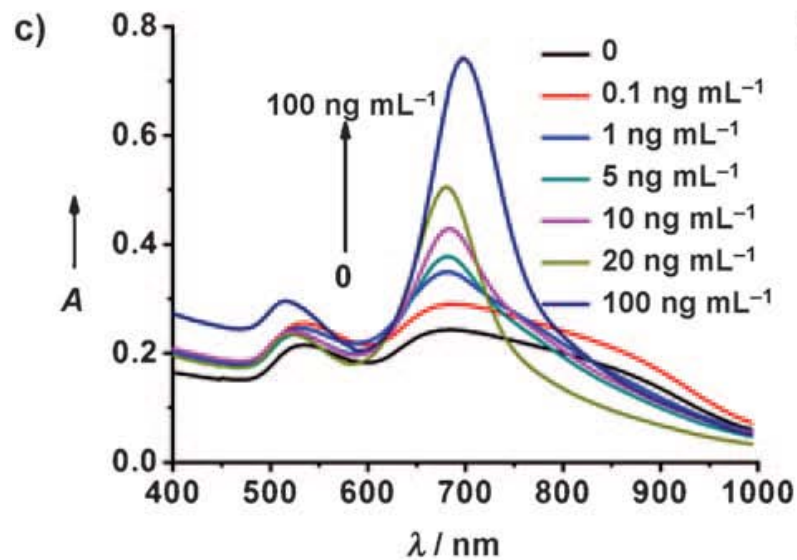
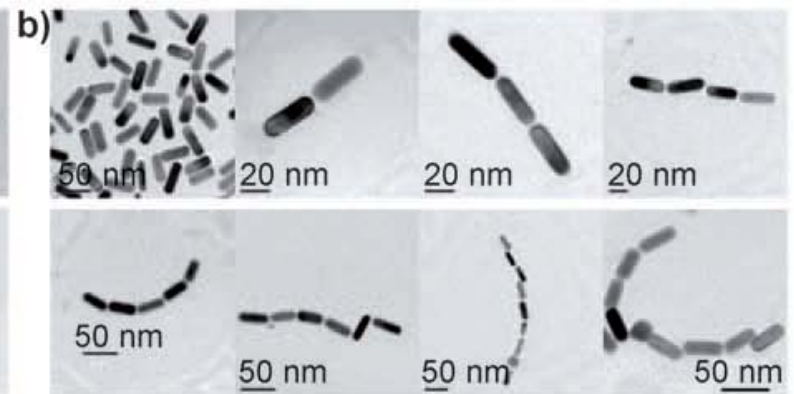
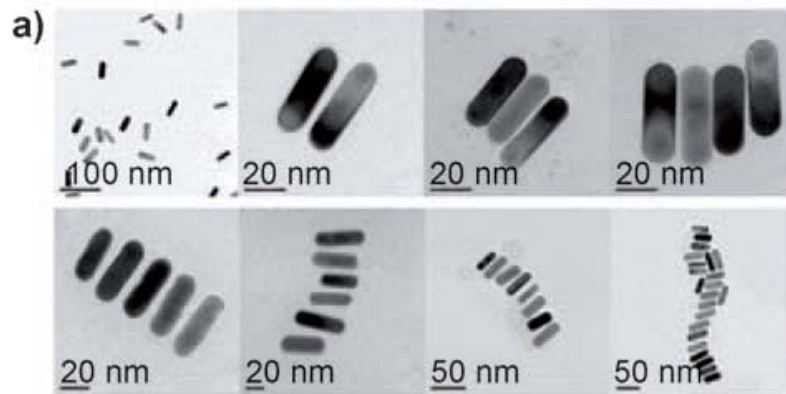


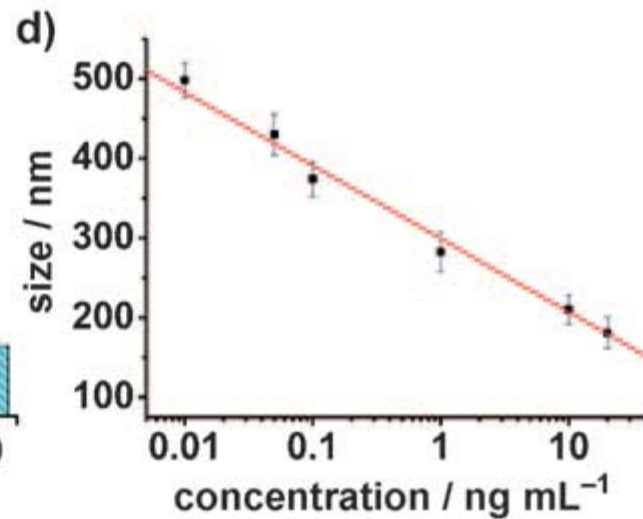
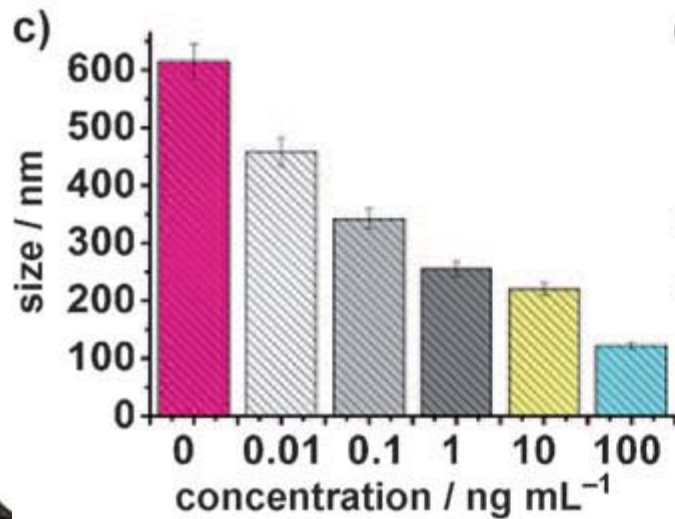
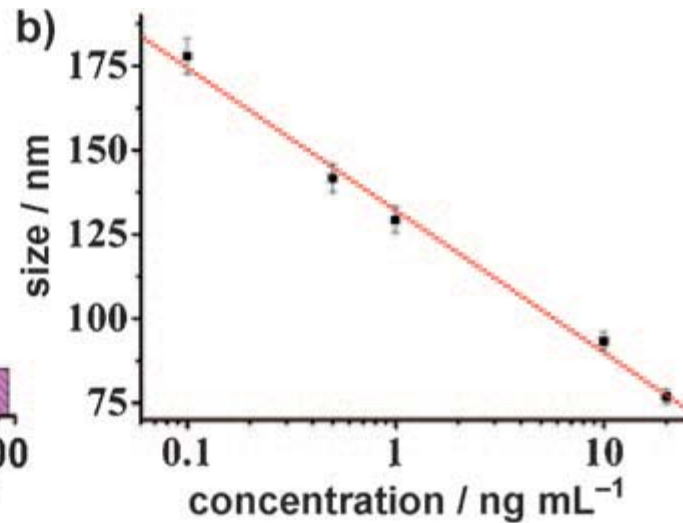
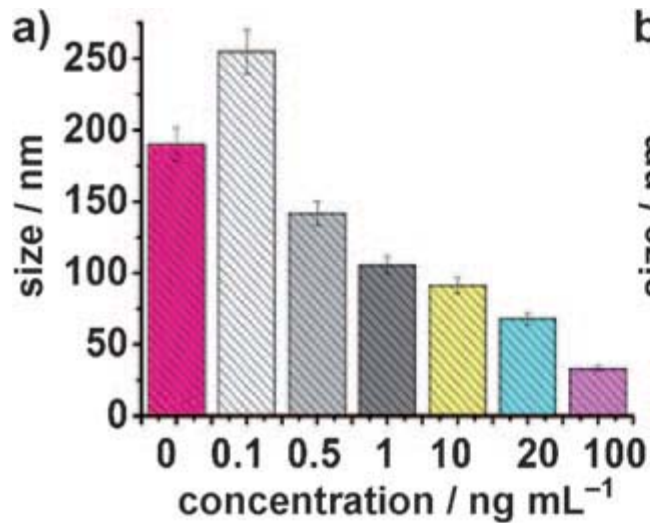
# Experimental

- ❖ **Synthesis of Au NRs: Seed mediated growth method**
- ❖ **Two kinds of protein-carrying Au NRs were synthesized**
  - 1) NR having MC-LR antibodies (ABs) preferentially on the sides (electrostatic binding)
  - 2) NRs with antibodies located almost exclusively in the ends (covalent attachment of the antibodies mediated by a bifunctional linker, thiocetic acid)
- ❖ **To complement the Au NRs modified either in the end or in the sides with ABs, their analogues carrying MC-LR OVA antigen were also synthesized**



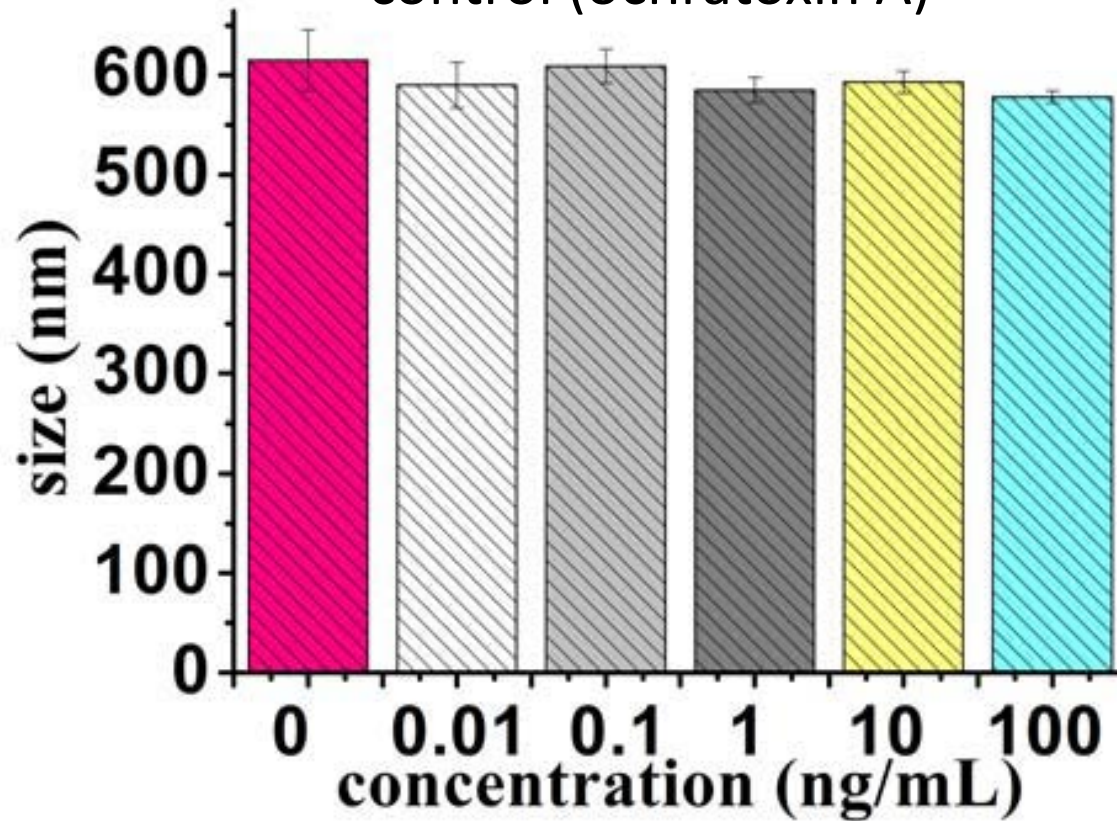






# Control Experiment

Change in hydrodynamic diameter in presence of control (ochratoxin A)



# Summary

- ✓ *MC-LR detection was successfully achieved with controllable assembly of Au NRs*
- ✓ *The side-by-side and end-to-end assembly of the Au NRs were realized using complementary AB and antigen.*
- ✓ *Sensitivity and detection ranges using UV/Vis spectroscopy and DLS are markedly better for the end-to-end motif.*
- ✓ *Sensing parameters for MC-LR using the NR assemblies surpass the required standard of drinking water by the World Health Organization ( $1 \text{ mgL}^{-1}$ ) and are substantially faster than existing methods*