Request for Report for Projects Awarded in 2013 and 2014 by

Mississippi Center for Food Safety and Post-Harvest Technology

Title: Nanoengineering Biologically-Active Surface Enhanced Raman Spectroscopic Tags for Ultrasensitive Food Pathogen Detections.
Award year: 2013-2014

PI: Dongmao Zhang

Co-PI: None

Collaborator: None

1. Objectives.

   Specific aim 1: Optimize the preparation and post-synthesis selection of gold-nanopartcle (AuNP)- and silver nanoparticle (AgNP)-based-POMCNs with uniform single-particle SERS activities.

   Specific aim 2: Explore the effect and mechanism of the organothiol backfilling on the biological activities of protein on the AuNP- and AgNP-based POMCNs. One of the most critical findings in PI's previous FSI project is that the biological activity and stability of proteins on AuNP can be modulated by backfilling the AuNP with organthiol or thiolated biomolecules.

   Specific aim 3: Demonstrate a POMCN-based pathogen detection schemes using *E coli* as the model pathogen. To this aim, POMCN functionalized with rabbit anti-*E. coli* antibody will be fabricated as the *E coli* SERS tag for detection of *E. coli immobilized on antimicrobial peptide cecropin functionalized microtiter plate.* The POMCN-based SERS *E coli* detection will be compared to that obtained with an anti-*E. coli* antibody-horseradish peroxidase conjugate.

2. New Accomplishments toward objectives. Please indicate if all objectives listed were completed.

   Specific aim 1: We have conducted a systematic study of the correlation between nanoparticle localized surface plasmonic resonance (LSPR) features and its SERS activity. The most important finding is that the NP LSPR is a reliable predictor of the optimal NP aggregation states for the SERS acquisitions, but not reliable for prediction of the optimal excitation wavelengths. This work has already been published in the Journal of Physical Chemistry C.

   Specific aim 2: We found that the structure of the backfilled organothiols have tremendous impact on the biological activities of the protein molecules immobilized onto the AuNP surfaces. Ongoing research effort has been on the mechanistic understanding of this phenomenon.

3. Objectives not accomplished and impediments to meeting objectives.

4. If continuing project, when will new and/or long term objectives be completed?

5. Students supported
   No students have been supported by this project.
   a. PhDs (% FTE and name)
   b. M.S. (% FTE and name)
   c. Undergraduate (number of students)
6. Leveraged Funds: External Competitive Funding Applied and Awarded based on findings from this project.
   a. Applied for:
      i. Funding agency
      ii. Program
      iii. Funding request ($$)
   b. Awarded:
      i. Funding agency
      ii. Program
      iii. Funding awarded ($$)
7. Outputs – In addition to the above, please populate the following sections to be included in a report to be compiled in a FSI Research Accomplishment Booklet. The project report will also be posted in a FSI website to be developed.

Project Deliverables. Below are the six peer-reviewed journal publications that acknowledged the FSI support received in 2014.

1. Perea, G. S.; Ansar, S. M.; Hu, S.; Chen, M.; Zou, S.; Pittman, C. U. and Zhang, D* (**2015**). "Iodide-induced organothiol desorption and photochemical reaction, gold nanoparticle (AuNP) fusion, and SERS signal reduction in organothiol-containing AuNP aggregates" ***Journal of Physical Chemistry C***. 119, 4261-4267. http://pubs.acs.org/doi/full/10.1021/jp512168z
2. Gadogbe, M.; Chen, M.; Zhang, D.*(**2015**). "Can para-aryl-dithiols cross-link two plasmonic noble nanoparticles as monolayer dithiolate spacers?" ***Journal of Physical Chemistry C***, 119, 6626-6633. http://pubs.acs.org/doi/abs/10.1021/acs.jpcc.5b00293
3. Zhang, D*.; Nettles C. (**2015**). "A generalized model on the effects of nanoparticles on fluorophore fluorescence in solution" ***Journal of Physical Chemistry C***, 119, 7941-7948. http://pubs.acs.org/doi/abs/10.1021/acs.jpcc.5b00597
4. Nettles, C. B.; Hu, J.; and Zhang, D*. (**2015**). "Using Water Raman Intensity to determine the effective excitation and emission path lengths of fluorophotometers for correcting fluorescence inner filter effect" ***Analytical Chemistry***, 87, 4917. http://pubs.acs.org/doi/pdf/10.1021/acs.analchem.5b005133
5. Ailin Wang, Karthikeshwar Vangala, Tam Vo, Dongmao Zhang, and Nicholas C. Fitzkee.* (**2014**). "*A Three-step Model for Protein-Gold Nanoparticle Adsorption*". **Journal of Physical Chemistry C**. 118, 8134-8142. http://pubs.acs.org/doi/abs/10.1021/jp411543y
6. Kumudu Siriwardana, Manuel Gadogbe, Siyam M. Ansar, Erick S. Vasquez, Willard E. Collier, Shengli Zou, Keisha B. Walters, and Dongmao Zhang.* (**2014**). "*Ligand Adsorption and Exchange on Pegylated Gold Nanoparticles***". Journal of Physical Chemistry C**. 118, 11111-11119. http://pubs.acs.org/doi/abs/10.1021/jp501391x