

UCSD NANOENGINEERING/CHEMICAL ENGINEERING
SPECIAL SEMINAR

Friday, August 30, 2019

Seminar Presentation: 10:00am – 11:00am

SME room 348**“Bio-functionalized gold nanoparticles: from design to application”****Roberto Fiammengo Ph.D.***Researcher - Team Leader**at the Center for Biomolecular Nanotechnologies
of the Italian Institute of Technology in Lecce*

Abstract: Gold nanoparticles (AuNPs) have been proposed for sensing applications,[1] in nanomedicine,[2] and to understand the interaction between engineered nanomaterials and biological systems.[3] Yet, limited efforts have been devoted to the development of biofunctionalized AuNPs with a precisely defined architecture at the molecular level. Our aim is to push forward the design,

preparation, and characterization of AuNPs functionalized with peptides, proteins or oligonucleotides to enable advanced biologically-oriented applications of these materials.

In the past years, we have developed a reliable coating strategy for the surface of AuNPs, which allows excellent control of nanoparticle functionalization and of colloidal stability.[4] In fact, the desired biomolecules are immobilized at low surface density on the negatively charged, hydrophilic nanoparticle coating maximizing their bioavailability. Using this approach, we have been able to prepare AuNPs targeting specific receptors on the cell membrane,[4,5] novel anticancer vaccine candidates,[6,7] and sensitive microRNA sensing systems.[8]

In this talk, I will first present our AuNP coating approach and then describe the bioconjugation strategies we follow for the immobilization of peptides, proteins, and DNA-probe sequences. Next, I will illustrate how the molecular design of these AuNPs is indeed crucial for their performances. In particular, I will present our recent results employing AuNP-based formulations to develop mucin 1-directed anticancer vaccines, and the use of biofunctionalized AuNPs to target cell receptors on the plasma membrane.

References: [1] K. Saha, S. S. Agasti, C. Kim, X. Li, V. M. Rotello, *Chem. Rev.* **2012**, *112*, 2739-2779. [2] D. Giljohann, D. Seferos, W. Daniel, M. Massich, P. Patel, C. Mirkin, *Angew. Chem., Int. Ed.* **2010**, *49*, 3280-3294. [3] X. Yang, M. Yang, B. Pang, M. Vara, Y. Xia, *Chem. Rev.* **2015**, *115*, 10410-10488. [4] L. Maus, O. Dick, H. Bading, J. P. Spatz, R. Fiammengo, *ACS Nano* **2010**, *4*, 6617-6628. [5] V. Maggi, F. Bianchini, E. Portioli, S. Peppicelli, M. Lulli, D. Bani, R. D. Sole, F. Zanardi, A. Sartori, R. Fiammengo, *Chem. Eur. J.* **2018**, *24*, 12093-12100. [6] H. Cai, F. Degliangeli, B. Palitzsch, B. Gerlitzki, H. Kunz, E. Schmitt, R. Fiammengo, U. Westerlind, *Biorg. Med. Chem.* **2016**, *24*, 1132-1135. [7] I. Compañón, A. Guerreiro, V. Mangini, J. Castro-López, M. Escudero-Casao, A. Avenoza, J. H. Busto, S. Castillón, J. Jiménez-Barbero, J. L. Asensio, G. Jiménez-Osés, O. Boutureira, J. M. Peregrina, R. Hurtado-Guerrero, R. Fiammengo, G. J. L. Bernardes, F. Corzana, *J. Am. Chem. Soc.* **2019**, *141*, 4063-4072. [8] F. Degliangeli, P. Kshirsagar, V. Brunetti, P. P. Pompa, R. Fiammengo, *J. Am. Chem. Soc.* **2014**, *136*, 2264-2267.

Biosketch: Roberto Fiammengo is since March 2012 researcher - team leader at the Center for Biomolecular Nanotechnologies of the Italian Institute of Technology in Lecce.

He studied chemistry at the University of Padua and received his Ph.D. in 2002 from the University of Twente, The Netherlands, working with David Reindhoudt in the fields of organic and supramolecular chemistry.

From 2003 to 2006 he worked as a postdoc at the University of Heidelberg (Germany) at the Institute of Pharmacy and Molecular Biotechnology developing nucleic acid-based hybrid catalysts for organometallic reactions.

In November 2006, he moved to Stuttgart (Germany) at the Max-Planck Institute for Intelligent Systems to start his independent academic career as a group leader in the Department of New Materials and Biosystems, working on the development of gold nanoparticles for biological applications. During the 5+ years there, he also worked on nanostructured hydrogel substrates for the investigation of cellular response to material compliance, and protein microarrays on nanostructured substrates.

In March 2012 he moved back to Italy joining the Center for Biomolecular Nanotechnologies of the Italian Institute of Technology in Lecce where he is currently leading a small research group mainly focusing on the design and application of biofunctionalized inorganic nanoparticles in diagnostics and nanomedicine. His scientific interests include: a) the development of novel and improved nanoparticle synthesis; b) the design of functional organic coatings; c) the synthesis of suitable linker molecules; d) the chemical functionalization of biomolecules; and d) the investigation of (bio)functionalization strategies. Some examples of the fields of application of his research include the quantification of microRNAs in sample of extracted total RNA, the development of nanoparticle-based vaccine formulations, the development of contrast agents and of improved silver-nanoparticle-based conductive inks.

He has published more than 30 research papers and filed 2 patent applications.