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NANOTECHNOLOGY SEMINARS

DOUBLE FEATURE

Aula 08 | Piso -1 | ETS de Ingenieros Industriales y de Telecomunicación

Polydopamine-assisted preparation of plasmonic substrates for Raman and SERS applications

Friday, 4th July 2025
12:00 pm

Ms. SERENA SCHIAVI - Universitá degli studi di Pavia

Serena Schiavi was born in 1998 in Milano, Italy. In 2020 she received her Bachelor's degree in Chemistry and in 2022 she received her Master's degree in analytical chemistry at the University of Pavia. Serena is currently a 3rd year PhD student in Chemical and Pharmaceutical Sciences and Industrial Innovation at University of Pavia. She is working under the supervision of Prof. Angelo Taglietti at inLAB, a nanochemistry group mainly specialized in the synthesis and fabrication of colloidal metal-nanoparticles and substrates.Her research is focused on the development of novel strategies for the fabrication of composite biopolymer-based plasmonic devices exploiting Raman and SERS for sensing applications of emerging water pollutants. Serena is currently completing her 7-month visiting period at University of Cantabria under the superivision of Dr. Leonardo Scarabelli at NanoOddLab. During her stay she focused her research combining the peculiar surface features of polydopamine and polynorepinephrine as future perspective for the fabrication of silver and gold metasurfaces.

From thin films to nanoparticles: MIPNEs as customizable bioreceptors for affinity-based protein detection

Friday, 4th July 2025
12:30 pm

Mr. SIMONE VENTISETTE - Universitá degli studi di Firenze

Simone Ventisette is a second-year PhD student in Chemical Sciences at the University of Florence. He holds a bachelor's degree in chemistry (Environmental and Cultural Heritage Chemistry curriculum) and a master's degree in chemistry (Chemical Sciences curriculum), both from the University of Florence.His current research focuses on the development of bioinspired molecularly imprinted biosensors based on catecholamine-derived polymers (e.g., polydopamine and polynorepinephrine), coupled with optical and acoustic transduction techniques such as Surface Plasmon Resonance (SPR), Bio-Layer Interferometry (BLI), and QCM-D. These systems are engineered for the selective recognition of proteins through peptide imprinting, with applications in both buffer and real biological matrices. He is currently working as a visiting PhD student in the laboratory of Professor Scarabelli at the University of Cantabria, where his research focuses on the patterned synthesis of polycatecholamine and the exploitation of its intrinsic reductive properties for the in-situ synthesis of ordered metal nanoparticle.

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ABSTRACT: In recent years the fabrication of composite materials based on polydopamine (PDA) has seen a staggering growth. This biopolymer exhibits remarkable adhesive properties emerging from surface weak interactions, as well as a reach chemistry related to its intrinsic reducing properties and to the presence of both amino and catechol groups that enable further functionalization. The versatility emerging from these physicochemical properties generated lot of interest from the most divers field of research.

In particular, the ability of dopamine to easily self-polymerize on a wide variety of surfaces has stimulated its combination with metal nanoparticles for the design of advanced optical biosensors based on surface enhanced spectroscopic techniques such as surface enhanced Raman spectroscopy (SERS). This is a powerful analytical tool capable of providing molecular fingerprints with high spatial resolution, offering high specificity for molecular characterization by taking full advantage of the signal enhancement provided by the electric field generated by an excited surface plasmon resonance.

In this seminar, I will present several examples of PDA composite plasmonic materials, covering both colloidal suspensions and solid substrates, employed for both Raman and SERS detection of emerging water pollutants. Moreover, in the last part of my talk, I will focus on some very recent data that demonstrate the nanostructuration of PDA (and PNE, polynorepinephrine), representing an exciting future perspective for the application of these materials for the preparation of plasmonic and photonic metasurfaces.

ABSTRACT: This seminar will present a new generation of molecularly imprinted biopolymers (MIPs) derived from the endogenous neurotransmitter norepinephrine (NE) that has recently been developed, showing remarkable capability for specific protein recognition. These synthetic receptors are prepared via monomer alkali-induced autoxidation in aqueous media at low temperature performed in the presence of peptide epitopes that serve as sacrificial templates for the formation of three-dimensional, highly selective binding sites.

Our group developed a rational peptide/epitope selection strategy, enabling the design of MIPNEs for a wide range of protein targets, ensuring high affinity and selectivity even in complex biological matrices. The ability to tune the morphology of MIPNEs—from surface-confined films to colloidal nanoparticles—provides significant flexibility in the design and implementation of affinity-based assays. We have successfully integrated MIPNEs into conventional optical biosensing platforms, including Surface Plasmon Resonance (SPR) and Fiber-Optic Bio-Layer Interferometry (BLI), demonstrating robust and reproducible performance in protein detection directly from human serum, using immunoglobulin G1 (IgG1) as a model analyte.

Beyond sensing, MIPNEs nanoparticles exhibit excellent biocompatibility and functional tunability, opening promising avenues for theranostic applications such as targeted drug delivery and selective protein scavenging. Overall, our findings highlight the efficacy, adaptability, and scalability of MIPNEs as synthetic, antibody-mimetic receptors, making them promising candidates as next-generation diagnostic and therapeutic technologies.

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