Anup Ghosh

Inspire Faculty
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Darshana Yazhini; Peptides on Plasmonic nanoparticles; Under progress

b) External Project Students / Summer Training

1. Suranjana Chakrabarty (Project Student); Peptides on Plasmonic nanoparticles
2. Swagata Maity (Visiting Student); Peptides on Plasmonic nanoparticles

Publications

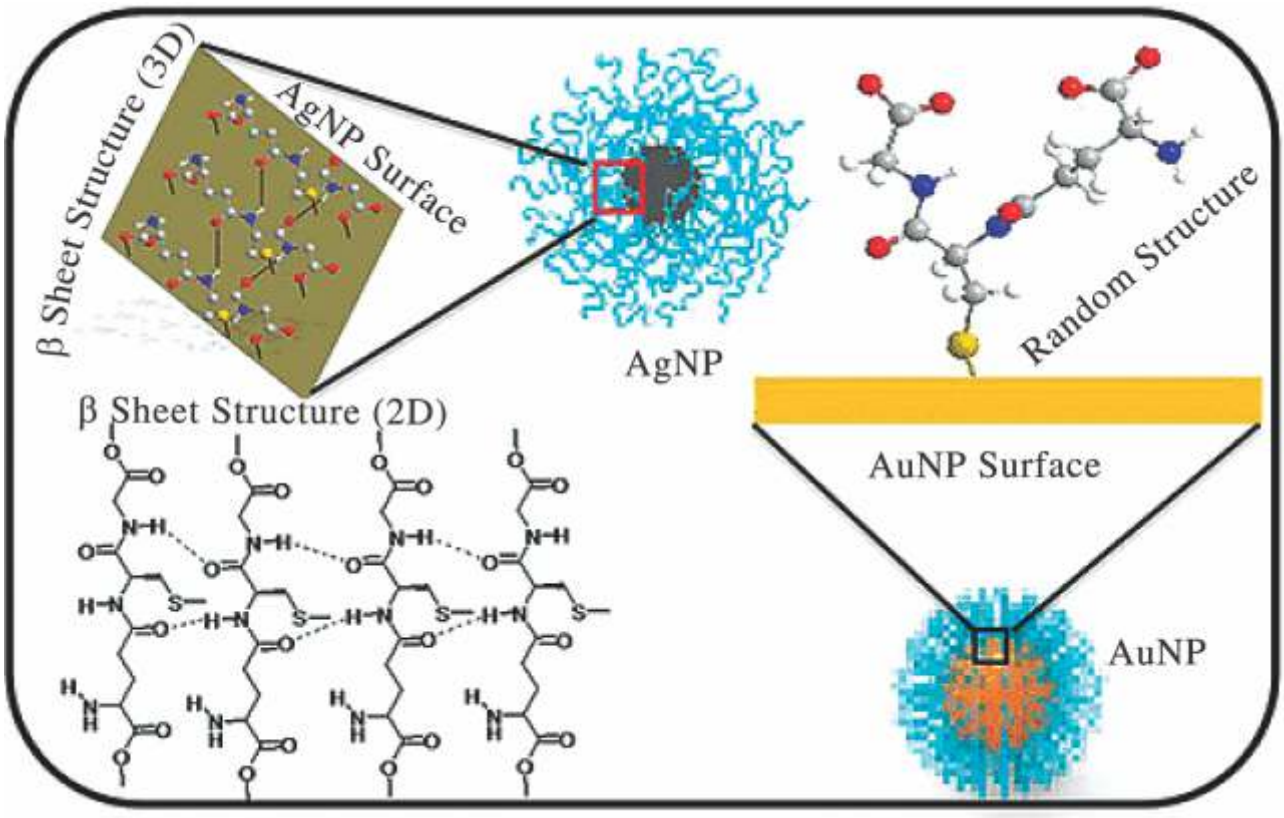
a) In journals

1. Suranjana Chakrabarty, Swagata Maity, Darshana Yazhini, and **Anup Ghosh**, *Surface-Directed Disparity in Self-Assembled Structures of Small-Peptide l-Glutathione on Gold and Silver Nanoparticles*, Langmuir, 36, 11255 – 11261, 2020

Areas of Research

Surface Enhanced Infrared Spectroscopy, Linear Infrared Spectroscopy, Ultrafast Two Dimensional Infrared (2D IR), Surface Ligands Conformation, Glutathione

Despite the key roles of L-glutathiones (GSHs) inbiology and nano-biotechnology, understanding their labile structures and hydrogen bond interactions with nanoparticles has posed a critical challenge to the scientific community. The structural conformation of GSH as a capping layer on gold nanoparticle (AuNP) and silver nanoparticle (AgNP) surfaces is investigated. In this report, we attempt to explore the material-dependent interaction of GSH with different spherical nanoparticle surfaces by employing Fourier transform infrared (FTIR) spectroscopy. The infrared signal of amide I of GSH is studied as a function of different materials' spherical nanoparticles with comparable size. We revealed the -sheet secondary structure of GSH on AgNPs and the random structure on AuNPs even though both the nanoparticles have comparable shapes and sizes and belong to the same group of the periodic table. The GSH is firmly anchored on the gold and silver surface via the thiol of the cys part. However, our experimental data designate a further interaction with the AgNP surface via the carboxylic acid group of the gly- and glu- end of the molecule. It is observed that enhancement of IR absorption of amide I of GSH is pronounced by a factor of 10 on AuNP but, in contrast, on the same-sized AgNP, the suppression is perceived by a factor of 2, even though both are plasmonic materials with respect to free GSH. This study can be used as a point of reference for understanding the structural conformation of the capping layer on nanoparticle surfaces as well as surface enhancement of the IR absorption of amide I. We would like to emphasize that molecular self-assembly on the nanoparticle surfaces is definitely of very broad interest for chemists working in nearly any subdiscipline, spanning from the nanoparticle-based medicine to surfaceenhanced spectroscopy to heterogeneous catalysis, etc.



Plan of Future Work Including Project

1. Infrared spectroscopy is the finger print spectroscopy for a specific molecule. But the sensitivity of this spectroscopy is less compare to UV-vis/fluorescence spectroscopy. To use IR spectroscopy significantly, we need to enhance the signal of infrared probes, so that lower concentrations of molecules can be measured easily. To enhance the absorption coefficient of vibrational transition for a particular molecule, SEIRAS has been introduced. SEIRAS is nothing but the surface enhanced infrared absorption spectroscopy where the absorption coefficient of a vibrational mode enhances in the environment of plasmon polariton of nano particles. We will compare the enhancement of different infrared probes for a particular size and shape of NP and also for a particular probe on different size and shape of NP from different materials. Furthermore, we will attach amide/peptides on NP where highest enhancement obtained from the above experiment. Using polarization-selective 2DIR spectroscopy, we will reveal the molecular conformations of amide/peptide on the surface of NPs with different size and shapes from different materials. The fibril-like structure of amide and peptides will be studied by using ultrafast 2D IR spectroscopy. The stability of the fibril structures in different pH and presence of different salt ion. Parallely we will compare the enhancement of amide and peptide signal in the presence and absence of different salt ion in different pH. We will compare the enhancement for different secondary structures on NP. The response of secondary structure with change in the environment is important not only for the chemical and nano-technological applications of the NPs, but also for NP-based medicine. For amide we may use glutathione, since it is abundant in the cytosol and can potentially exchange with various NP ligands. Internalized NPs with GSH SAM eventually reach the acidic lysosome, where the fibril-like structure on their surface may initiate various processes.