Dean’s Colloquium

Dr. Anupam Das, Assistant Professor
Department of Chemistry and Biochemistry

When: April 3rd (Wednesday), 2024
3:00 – 3:20 pm, Q & A: 10 min
Where: Turner Hall #129

Title: Development of SERS-based ‘point-of-need’ analytical tools for highly sensitive detection of analytes in forensic, biological, and environmental samples

Abstract: Despite enormous progress in detection, analysis, and quantification of harmful analytes, we often face outbreaks of diseases, contamination in food and medications, and pollution in natural resources. They could have been prevented by using faster, sensitive, and readily available ‘on-site’ detection techniques. Although several techniques for the detection of contaminants in a variety of matrices are available, monitoring each class of analyte requires specific instrumentation. Surface-enhanced Raman scattering (SERS) has emerged as an alternative, rapid, sensitive, versatile analytical technique to tackle the limitations of traditional ones. The SERS platform is an inexpensive, robust, and non-destructive method to analyze single or multiple contaminants simultaneously. In real-life analytical applications, SERS has the advantages of portability, i.e., ‘on-site’ and ‘point-of-care’ analysis. No pre-treatment of samples, identifying molecules in the ‘fingerprint region’, analyzing samples both in label-free and labeled modes, removal of fluorescence background signals, high signal-to-noise ratio, excellent multiplexing, and low photobleaching (unlike fluorescence) capabilities are other edges of SERS. With the advantages, SERS-based analytical techniques can reportedly attain an extremely high limit of detection (LoD) value down to aM (10^{-18} mol L^{-1}) level. Due to the extraordinary signal enhancement capability, when SERS is conjugated with other handy detection tools, like microfluidics, the sensitivity of the detection multiplies exponentially compared to that of the traditional visible colors. We will use lateral-flow assay (LFA) paper strips for detection of the forensic and bio samples, more specifically drug (fentanyl) and biomarkers. The localized-surface plasmon resonance (LSPR) fields of the gold nanoparticles (AunP), upon aggregation at the test line on the LFA strip, create a huge number of plasmonic ‘hot-spots’. The hotspots are responsible for the extraordinary enhancement of the Raman signals of the analytes present at the LSPR fields of the AunPs as SERS. The method is capable of detection of the trace fentanyl, biomarkers, and pollutants found in crime scenes, body fluids, and environmental samples in the nM level and beyond.

Bio: Dr. Anupam Das joined Hampton University in January 2024 as a faculty member in the Chemistry and Biochemistry Department. Dr. Das received a Doctorate degree in Chemistry from Indian Institute of Technology (IIT) Indore. His PhD thesis was based on the interactions of anticancer drug molecule-loaded liposomes with DNA and proteins and their impacts on the photophysical properties of the drug molecules. He then completed postdoctoral training at Chung-Ang University, Penn State University, and SUNY Binghamton. In his postdoc research, he mostly worked on synthesis and characterization of Raman and fluorescence nano probes for detection and imaging of biomarkers, pollutants, and pathogens. At HU, his research interests primarily focus on development of ‘point-of-need’ analytical tools for highly sensitive detection of analytes from the forensic, biological, and environmental fields. He will be mostly using SERS as the detection technique.