Rapid Diagnostics for Infectious Diseases Using Gold Nanoparticles

Kimberly Hamad-Schifferli

University of Massachusetts - Boston

Friday, February 11th, 3:30 – virtual presentation

Zoom Link:
https://ucf.zoom.us/j/97856267836?pwd=eFJSYnhLWWlYY1hoVVhQV040cVRMQT09

Meeting ID: 978 5626 7836
Passcode: 125747

Host: Qun Huo

The global COVID-19 pandemic has underscored the need for innovations in disease diagnostics. The convergence of the fields of nanotechnology and medicine has resulted in new approaches for novel disease therapies, biomedical imaging and sensing, and numerous others. In particular, the use of gold nanoparticles in rapid diagnostics for infectious diseases has been emerging as an application with the potential to address some of the major challenges in global health. These assays are low-cost and can be used in rugged environments, so they are attractive for widespread deployment for disease surveillance, quarantining, and treatment. Readout by eye is made possible by the gold nanoparticle-antibody conjugates, which have a strong absorption due to the nanoparticle surface plasmon resonance, thus providing sample-to-answer times of minutes. One opportunity for extending the capabilities of paper immunoassays that are not possible with traditional paper immunoassays lies in exploiting the unique size and material dependent properties of the nanoparticles. We describe a route for leveraging the optical properties of gold nanostars to use paper immunoassays for multiplexed diagnostics for yellow fever, dengue, and zika viruses. By adapting immunoassays for selective sensing as opposed to specific sensing and using machine learning of the color test lines, we are able to construct an assay for yellow fever non structural protein 1(NS1)

using cross-reactive antibodies raised for dengue and zika. In addition, we discuss routes to increase the sensitivity of paper-based immunoassays via surface enhanced Raman spectroscopy (SERS). By using gold nanostars for Raman nanotags with different Raman reporter molecules, we can construct multiplexed assays for zika and dengue. We also discuss challenges associated with the biotic-abiotic interface in paper based immunoassays, which result in undesirable side effects such as non-specific adsorption and false positives.