Electrochemiluminescence (ECL) biosensors for Medical Diagnostics and Environmental Monitoring

PhD Seminar

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Electrochemiluminescence (ECL) biosensors have emerged as a powerful analytical tool, overcoming major limitations of conventional methods by offering rapid, highly sensitive, and selective detection of chemical species and biomolecules. These biosensors are built on the concept of ECL technique, where light generated by the electrochemical reactions at the electrode surface is analyzed. The luminescence produced by electrochemically formed excited species minimizes the background interferences, resulting higher sensitivity and when this is combined with the biomolecules that has the capability to specifically recognize and bind the target; increases the selectivity. Additionally, ECL biosensor can detect multiple analytes simultaneously and on top of that ECL reactions are controllable increasing the reproducibility. Herein, this talk will explore the application of ECL biosensor for the early detection of the cancer biomarkers in the human health and the ultra-trace detection of uranium in the environmental samples.

Cancer is the second-leading cause of deaths in the United States. One factor that could somehow improve the patient's survival rate would be the early diagnosis of the cancer. But the fact that the current imaging techniques could rarely detect tumor cells at its early stage and the extended time required for the sample preparation, analysis and the result interpretation for the biofluid assays like ELISA, PCR highlights the limitation of the available diagnostic techniques for the early diagnosis of disease.

Uranium is a naturally occurring radioactive metal and the exposure of the Uranium to the environment could be during its mining and processing. Uranium can be the present in the environment in the ultra-trace level but even the low concentration of Uranium is enough to contaminate the water sources, soil, and even air leading to potential health risks to human and wildlife. Thus, highly sensitive and selective analytical tool like ECL biosensors is required to detect Uranium in the environment samples.

Here, I will discuss various fabrication steps involved in the development of the ECL biosensors, as well as signal amplification strategies to further enhance their sensitivity and performance in detecting both the cancer biomarkers and Uranium.