Highly sensitive biosensor based on electrochemiluminescence technique

The transition metal compound tris (2, 2'-bipyridyl) ruthenium (II) ($Ru(bpy)_3^{2+}$) is one of the most commonly used ECL probes, and its bioanalytical applications have been investigated during the past two decades. For immunoassay, ECL of $Ru(bpy)_3^{2+}$ has been demonstrated to be more sensitive than the classical enzyme-linked immunosorbent assays (ELISAs). Despite the significant advance, in our opinion, the potential of $Ru(bpy)_3^{2+}$ ECL probe is still largely unexplored. Especially, the development of a nucleic acid-based ECL reporter will be promising for expanding its applications in the field of disease diagnosis, environmental monitoring, and food safety.

With the support of the National Natural Science Foundation of China, the research team led by Profs. Xing Da and Zhou Xiaoming from the MOE Key Laboratory of Laser Life Science & Institute of Laser Life Science, College of Biophotonics, South China Normal University, have presented a detailed protocol for preparing $Ru(bpy)_3^{2+}$ probes and their bioanalytical applications. This published technique details include: (i) the synthesis of a biologically active $Ru(bpy)_3^{2+}$-N-hydroxysuccinimide (NHS) ester, (ii) its covalent labelling with both antibodies and DNA probes, and (iii) the detection and quantification of ECL in a microfluidic system with a paramagnetic microbead solid support (*Nature Protocols*, 2014, 9(5): 1146—59). Recently, they also made great progress in the construction of ECL signal amplification probes and the microfluidic ECL detection platform (*Analytical Chemistry*, 2014, 86: 4596—4604; *Biosensors and Bioelectronics*, 2014, 58: 388—394; *Analytical Chemistry*, 2010, 82: 3099—3103; *Analytical Chemistry*, 2009, 81: 255—261). It has been demonstrated that detection sensitivity can be further enhanced through the design of a new ECL biobarcode method based on nucleic acids-gold nanoparticles (AuNPs) or cysteamine-AuNPs conjugates. The transduction is based on the formation of a sandwich complex that contains a biotin labelled capture probe, target DNA, and ECL nanoprobes. Telomerase extension products, DNA from genetically modified organisms, and miRNAs can be directly detected with satisfied sensitivity without relying upon the PCR amplification. This is a significant advance in the field of nucleic acids molecular diagnosis because amplification-related errors can be avoided; thus, more accurate and more reliable data can be obtained.

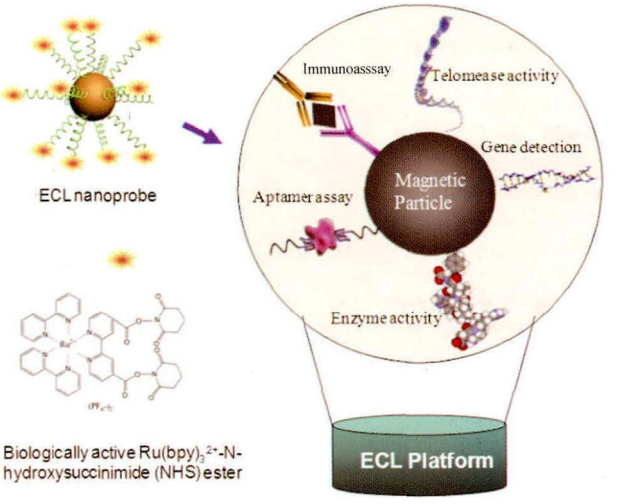

Figure The concept of highly sensitive bioassays based on ECL technique on a magnetic platform.