Electrochemiluminescence (ECL) and Its Solid-state Detector

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Electrochemiluminescence (ECL) has proved to be a useful analytical technique that combines the simplicity of electrochemistry with the inherent sensitivity and the wide range of chemiluminescence (CL) method. Unlike some other CL reagents, which are consumed in the ECL reaction, Ru(bpy)$_3^{2+}$ is regenerated during the ECL process. As the result, a reagentless ECL sensor can be constructed by immobilizing the Ru(bpy)$_3^{2+}$ on an electrode surface. Compared with the solution-phase ECL procedure, the immobilization of the Ru(bpy)$_3^{2+}$ makes experimental design simple and the cost low because there is no need to deliver extra Ru(bpy)$_3^{2+}$ reagent, such as reducing consumption of expensive reagent, simplifying experimental design and enhancing the ECL signal and selectivity by functionalized modified electrode. It is developed as useful cost-effective, regenerable solid–state ECL sensors.

The combination of capillary electrophoresis (CE) with electrochemiluminescence (ECL) i.e. CE-ECL analyzer developed in our laboratory being as a commercial product. It contains different units of capillary and microchip capillary electrophoresis, voltammetric analyzer, chemiluminescence and electrochemiluminescence which can be used separately and/or combined together as a hyphenated instrument with a chip-type Ru(bpy)$_3^{2+}$ ECL detection cell for capillary electrophoresis and flow injection analysis and microchip capillary electrophoresis with solid–state electrochemiluminescence etc.

In this report both the recent result of the CE/ECL and the solid-state Ru(bpy)$_3^{2+}$ in our State Key Laboratory of Electroanalytical Chemistry will be described. We would stress the use of nanomaterials to increase sensitivity and selectivity, to improve the stability and durability, to make suitability and applicability of this newly developed technique. The solid sensor can also be functionized with cation-exchange polymer like Nafion as well as Eastman AQ at glassy carbon (GC) or carbon nanotube (CNT) as well as silica/AQ/Ru(bpy)$_3^{2+}$ thin film–modified electrode to increase selectivity significantly, magnetic nanoparticles and other materials investigated to develop cost-effective, regenerable solid–state ECL sensors etc.

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