

Review

Recent Advances in Luminophores for Enhanced Electrochemiluminescence Analysis

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Abstract: Electrochemiluminescence (ECL) detection is widely applied in many fields, including chemical measurement, biological analysis, and clinic tests, due to its high sensitivity. Currently, the fast development of many new electrochemical luminophores is continuously improving the ECL-based detection ability. Besides the enhancement of luminescence emission for a high detection sensitivity, minimizing the effect of co-reactants on ECL detection and achieving multiple analysis in one sample are also the main directions in this field. This review focuses on a summary of recently prepared new luminophores to achieve the three aims mentioned above. Especially, the review is composed by three parts, focusing on the luminophores or materials with high ECL efficiency, self-enhancing properties, and multi-color ECL luminophores. The fabrication of biosensors using these molecules is also reviewed to exhibit the advances in biological applications.

Keywords: electrochemiluminescence detection; high-luminescent luminophores; intramolecular luminescent luminophores; spectral-dependent luminophores; biosensing

1. Introduction

Electrochemiluminescence (ECL) is a light emission process that includes the redox reactions on the electrode surface under a certain voltage. Since the luminescent reagent is excited and emits light without the need for any other light source, ECL has the advantages of a high sensitivity and low background signal [1–3]. Accordingly, since its discovery, electrochemiluminescence (ECL) technology has received great attention from the scientific community and has been widely applied in the fields of biological analysis, environmental monitoring, food safety, and medical diagnosis [4–9]. Typically, the annihilation and co-reaction pathways are two popular mechanisms for ECL, in which the co-reactive pathway is mostly used [10–13]. In this pathway, the luminescent reagent (e.g., ruthenium complex) is oxidized or reduced at the electrode, and the co-reactants (e.g., tri-*n*-propylamine or hydrogen peroxide) help the luminescent reagent to generate excited-state substances and provide additional electrons or reaction intermediates [14,15]. The intermediate is energetically unstable, and thus, it returns to the ground state, releasing energy and emitting visible light in the form of photons. The involvement of co-reactants not only improves the luminescence efficiency but also increases the sensitivity. It is noted that the presence of co-reactants can still lead to some negative effects, such as increased background noise and instability of the ECL signal.

Luminophores and co-reactants, electrode materials, pH, potentials, etc., have a great impact on ECL generation and the performance of ECL analysis [16–19], among which luminophores are the most important component in ECL detection. These luminophores with different luminescence efficiencies determine the sensitivity and effective detection range of ECL analysis. Therefore, obtaining new luminophores with high ECL efficiency is always the first task in this field. Thanks to the rapid development of materials science, ECL detection technology is experiencing an unprecedented development momentum,



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Advances In Multidimensional Luminescence

Michael Hoelscher



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Table of Contents Advances In Multidimensional Luminescence

1. Understanding the eBook Advances In Multidimensional Luminescence
 - The Rise of Digital Reading Advances In Multidimensional Luminescence
 - Advantages of eBooks Over Traditional Books
2. Identifying Advances In Multidimensional Luminescence
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Advances In Multidimensional Luminescence
 - User-Friendly Interface
4. Exploring eBook Recommendations from Advances In Multidimensional Luminescence
 - Personalized Recommendations
 - Advances In Multidimensional Luminescence User Reviews and Ratings
 - Advances In Multidimensional Luminescence and Bestseller Lists
5. Accessing Advances In Multidimensional Luminescence Free and Paid eBooks
 - Advances In Multidimensional Luminescence Public Domain eBooks
 - Advances In Multidimensional Luminescence eBook Subscription Services
 - Advances In Multidimensional Luminescence Budget-Friendly Options

6. Navigating Advances In Multidimensional Luminescence eBook Formats
 - ePub, PDF, MOBI, and More
 - Advances In Multidimensional Luminescence Compatibility with Devices
 - Advances In Multidimensional Luminescence Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Advances In Multidimensional Luminescence
 - Highlighting and Note-Taking Advances In Multidimensional Luminescence
 - Interactive Elements Advances In Multidimensional Luminescence
8. Staying Engaged with Advances In Multidimensional Luminescence
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Advances In Multidimensional Luminescence
9. Balancing eBooks and Physical Books Advances In Multidimensional Luminescence
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Advances In Multidimensional Luminescence
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Advances In Multidimensional Luminescence
 - Setting Reading Goals Advances In Multidimensional Luminescence
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Advances In Multidimensional Luminescence
 - Fact-Checking eBook Content of Advances In Multidimensional Luminescence
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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