High-stable Phosphorene-supported Bimetallic Pt-Pd Nanoelectrocatalyst for *p*-Aminophenol, β -Galactosidase, and *Escherichia coli*

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Phosphorene (BP) is a rapidly rising star in two-dimensional (2D) layered nanomaterials beyond graphene, and its urgent issues of ambient instability still have to be resolved. Here, the bimetallic Pt-Pd nanoparticle on the BP surface was employed as multifunctional chemical and biochemical sensing platform for electrocatalytic detection of *p*-aminophenol (PAP), β -galactosidase (β -Gal), and *Escherichia coli* (*E. coli*). The BP-supported Pt-Pd nanoelectrocatalyst obtained by the electrodeposition of bimetallic Pt-Pd nanoparticle onto the BP surface was very stable in aqueous buffer containing oxygen, which displayed good voltammetric responses for PAP in a linear range of 0.02 - 5 $\mu\text{mol}\cdot\text{L}^{-1}$ with a detection limit (LOD) of 1.41×10^{-8} M and sensitivity 115.81 $\mu\text{A}\cdot\mu\text{M}^{-1}\cdot\text{cm}^{-2}$. PAP could be obtained by the biochemical reaction of β -Gal in the presence of substrate PAP- β -galactopyranoside, which could realize for biochemical sensing of β -Gal in a linear range of 0.2 - 0.8 $\text{mU}\cdot\text{L}^{-1}$ with a LOD of 9.35 $\text{nU}\cdot\text{L}^{-1}$ and sensitivity of 4.77 $\mu\text{A}(\text{mU}\cdot\text{L}^{-1})^{-1}\cdot\text{cm}^{-2}$. The β -Gal is an indicator of total coliforms represented by *E. coli* that are induced by isopropyl- β -thiogalactopyranoside, which could applied for biochemical sensing of *E. coli* in a linear range of $6 \times 10^6 - 1.6 \times 10^8$ $\text{cfu}\cdot\text{mL}^{-1}$ with LOD of 6.65×10^5 $\text{cfu}\cdot\text{mL}^{-1}$ and sensitivity of 2.44 $\mu\text{A}(\text{cfu}\cdot\text{mL}^{-1})^{-1}\cdot\text{cm}^{-2}$. This work will provide experimental support for multifunctional chemical and biochemical sensing platform based on 2D layered nanomaterials decorated with bimetallic nanoelectrocatalysts.

Keywords: Phosphorene; Bimetallic nanoparticles; *Escherichia coli*; β -Galactosidase; *p*-aminophenol.

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