Calibration-free flexible voltammetric pH sensor based on pen drawing graphene flake/PEDOT ink electrode

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Hydrogen ion concentration (pH) known as the most important biochemical property in all natural environment can in most cases be electrochemically determined by measuring the potential difference between the inner and the outer concentrations of H^+ separated with a glass membrane. However, traditional glass membrane-based pH meters commonly require labor-intensive maintenance protocols including periodic calibration for correct working of the pH probe. In this work, a calibration-free flexible voltammetric pH sensor which can operate in a three electrode electrochemical system is introduced. Each electrodes, i.e., Ag/AgCl reference electrode, quinone/hydroquinone-immobilized graphene flake (GF)/poly(3,4-ethylenedioxythiophene) (PEDOT) working electrode, and GF/PEDOT counter electrode, are separately formed by pen drawing the functionalized GF/PEDOT inks on a flexible polyethylene terephthalate substrate. Results show that the redox peak potential of the voltammetric pH sensor increases with a decrease of pH. The measured sensitivity is about -100 mV per pH in the linear range of pH 3.8 to pH 7.8.