Short Communication

All-solid-state Ca^{2+} Ion-selective Electrode with Black Phosphorus and Reduced Graphene Oxide as the Mediator Layer

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doi: 10.20964/2019.06.45

Received: 29 January 2019 / Accepted: 23 March 2019 / Published: 10 May 2019

An all-solid-state Ca^{2+} ion-selective electrode (Ca^{2+} -ISE), employing a composite mediator layer of reduced graphene oxide (RGO)-coated black phosphorus (BP), was developed and analyzed. The morphological characteristics of the prepared Ca^{2+} -ISE were compared with those of other Ca^{2+} -ISEs with solid-contact monolayers of RGO or BP. The potentiometric performance of the designed ISE was systematically verified. An ideal Nernstian response was observed with a stable linear range from 1.0×10^{-6} – 1.0×10^{-1} M, a response slope of 28.3 mV/decade, and a limit of detection of 7.2×10^{-6} M. Due to the outstanding hydrophobic performance of the RGO-coated mediator film, the potential drift of the Ca^{2+} -ISE decreased to 0.01 mV s^{-1} . In addition, the ISE demonstrated good stability with a negligible potential variation of less than $2.86 \text{ } \mu\text{V s}^{-1}$ when exposed to a variety of interferences, such as ambient light and gases. The sensitivity was maintained at a satisfactory level after continuous use over 10 days. Real lettuce nutrient solutions were applied to validate the feasible application of this ISE. Promising capabilities were found with detection recovery rates ranging from 87% to 112%.

Keywords: Calcium; All-solid-state ion-selective electrode; Black phosphorus; Reduced graphene oxide; Composite mediator layer.

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