Determination of Sulfate in Seawater by a Novel All-Solid-State Sulfate Sensor with H₂SO₄ Doped Polyaniline as Sensitive Membrane

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An all-solid-state sulfate selective-electrode, with Au wire as the substrate and H₂SO₄ doped polyaniline (PANI) as the sensitive membrane, has been proposed. The effect of polymeric monomers concentration, oxidization potential, and solvent component on the electrochemical reaction has been optimized for further improving the performance of the electrode. The membrane is prepared by electro-polymerization with 0.1 M aniline hydrochloride dissolved in 1 M H₂SO₄, 0.0005 sampled interval, and setting scanning potential at 0.8 V give the excellent Nernstian linear response to sulfate in the concentration range of 8.0×10^{-5} to 1.0 M of Na₂SO₄ solutions made by freshly prepared 3.5% NaCl solution, with a slope of -26.62 mV per decade ($R^2 > 0.99$). The potentiometric response of the electrode is independent of pH in the range of 5.5-8.5. The scanning electron microscope (SEM) observation reveals that H₂SO₄ doped PANI formed cross-linked rods nearly 0.2-0.4 μm in length and 0.1 μm in thickness on the surface of the Au wire. Bulk impedance of the electrode is about 36 Ω , much lower than the glass and poly (vinyl chloride) (PVC) electrode reported. The utility of the new sulfate electrode has been used as a sensor for the determination of sulfate concentration in seawater successfully. Particularly, the electrode is in a small size and convenient for both integrate and assembly to capture *in-situ* data in distant and inaccessible sites, which is superior to those existing jelly-like and mechanically non-robust sulfate electrodes for real-word *in-situ* monitoring.

Keywords: Sulfate determination; All-solid-state sulfate electrode; Polyaniline; *In-situ* measurement; Low impedance

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