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Solid-State Environmental Chemical Sensor for Eutrophication-Ion in Closed Natural System

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Summary

A new function of perovskite-type oxide based electrode was proposed for electrochemical chemical sensor device. A novel sol-gel processing technique was developed for the preparation of La-based perovskite-type fine-powders and thin-films using an acetylacetone - poly(vinyl alcohol) (PVA) polymeric precursor method. The PVA-based gel made it possible to deposit a thin-film as well as to lower the sintering temperature as low as 500ºC. Carbon-based electrodes loaded with perovskite-type oxides showed good sensing properties to hydrogen-phosphate ion. Amperometric sensing to HPO_4^{2-} of the carbon electrodes loaded with various perovskite-type oxides have been also investigated. The anodic current of a carbon-based electrode loaded with La-Co based perovskite-type oxide, the sensing signal, was increased with increasing the concentration of hydrogen-phosphate. The $LaCoO_3$ thin-film sensor device showed high sensitivity and high anion selectivity with fastest response time to HPO_4^{2-}. A new solid-electrolyte ion sensor device using a Na^+-ion conductor ($Na_5DySi_4PO_{12}$: NDSO) as an impedancemetric transducer and a perovskite-type oxide thin-film as a receptor has been also developed. The AC impedance of the device with a $LaCoO_3$ receptor was found to vary logarithmically with increasing K_2HPO_4 concentration between 1.0×10^{-5} and 1.0×10^{-2} M at 10 kHz. The 90% response time was ca. 2 min at room temperature. The sensor showed a little sensitivity to NO_3^- at higher concentration, while no response was observed to the examined anions of Cl^- and ClO_4^-.