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Innovation of Novel Stone-Like Perovskite Structured Calcium Stannate ($CaSnO_3$): Synthesis, Characterization, and Application Headed for Sensing Photographic Developing Agent Metol(Article)

Muthukutty, B., Krishnapandi, A., Chen, S.-M., Abinaya, M., Elangovan, A.

[a]Electroanalysis and Bioelectrochemistry Lab, Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, No. 1, Section 3, Chung-Hsiao East Road, Taipei, 106, Taiwan
[b]Department of Chemistry, VHNSN College (Autonomous), 3/151-1, College Road, Virudhunagar Tamil Nadu, 626001, India
[c]Department of Chemistry, Thiagarajar College, 139, Teppakulam West St, Kamarajar Salai, Madurai Tamil Nadu, 625009, India

Abstract

Inorganic perovskite-based alkaline earth oxide materials for electrochemical sensing devices are an unwrapped research field yet to be studied. Herein, we designed a novel perovskite-type calcium stannate ($CaSnO_3$) material with stone-shaped structural morphology synthesized by a simple coprecipitation method with the aid of urea and utilized as an electrocatalyst for the electrochemical detection of photographic developing agent metol (MT). The synthesized $CaSnO_3$ was systematically characterized with the help of X-ray diffraction (XRD), Raman, Fourier-transform infrared spectroscopy (FT-IR), field emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy, elemental mapping analysis, high resolution transmission electron microscope (HR-TEM), and electron spectroscopy for chemical analysis (ESCA). Furthermore, the electrochemical property of $CaSnO_3$ was examined by cyclic voltammetry and differential pulse voltammetry techniques. As a result, $CaSnO_3$ modified with a glassy carbon electrode ($CaSnO_3$/GCE) implies better electrocatalytic activity with an enhanced redox peak response, wider linear range (0.01-123 μM), lower detection limit (0.003 μM), and appreciable sensitivity toward the detection of MT. In addition to that, the $CaSnO_3$ modified electrode has excellent selectivity with the existence of potentially interfering compounds such as cationic/anionic species and biological substances. Moreover, the $CaSnO_3$ modified electrode has better reproducibility, repeatability, and storage stability. Further, the practical viability of the synthesized $CaSnO_3$ was investigated by using lake water as a real sample, revealing reasonable recovery results. © 2020 American Chemical Society.

Author keywords

Differential pulse voltammetry technique | Metol | Perovskite $CaSnO_3$ | Photographic developing agent | Redox behavior

Indexed keywords

Engineering controlled terms: Alkalinity | Calcium | Chemical detection | Cyclic voltammetry | Electrocatalysts | Electron spectroscopy | Energy dispersive spectroscopy | Field emission microscopes | Fourier transform infrared spectroscopy | Glass membrane electrodes | High resolution transmission electron microscopy | Perovskite | Scanning electron microscopy | Spectrum analysis | Urea

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Chen, S.-M.; Electroanalysis and Bioelectrochemistry Lab, Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, No. 1, Section 3, Chung-Hsiao East Road, Taipei, Taiwan;