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Enhanced cobalt-based microelectrode and nano-textured phosphate sensor for *in situ* phosphate measurement in drinking water systems

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Orthophosphate is used as a corrosion inhibitor in drinking water utilities by forming a microscale passivating surface layer on metal pipes of distribution systems. However, phosphate consumption by metal pipes and the associated role of phosphate on water chemistry, dynamics of metal oxidants (e.g., free chlorine and oxygen) remains unclear. A previously developed cobalt-based potentiometric phosphate microelectrode was used to study activated sludge flocs; however, for drinking water and/or fresh water application, the limit detection needed to be improved (e.g., 10 ppb). In addition, oxygen interference limited its use in microenvironments where oxygen gradients are found (e.g., the metal surfaces of drinking water pipelines). This research presents two cobalt-based electrochemical microsensors (15–45 μm of tip diameters) using cobalt wire and cobalt electroplating for fabrication. The sensors were fully characterized in terms of amperometric measurement, limit of detection, response time, lifetime, ion interference, and reproducibility. Subject to an applied potential of -400 mV (vs. Ag/AgCl), the sensors showed an excellent linear response to various phosphate concentrations ranging from 10^{-2} to 10^{-8} M with a sensitivity of 18 pA/pC and were not affected by the presence of oxygen. The developed microsensors were also used to measure *in situ* phosphate concentration gradients of ductile iron surfaces in simulated drinking water conditions. The cobalt-based microsensors, with improved limit of detection of 0.31 ppb, will greatly improve our understanding of the phosphate's impact on drinking water pipelines and various water systems.

Biography

Woo Hyoung Lee, PE, is an Assistant Professor in the Department of Civil, Environmental, and Construction Engineering at the University of Central Florida. He received his PhD in Environmental Engineering from the University of Cincinnati in 2009. He has published more than 17 papers in reputed journals and is serving as an Editorial Board Member of *The Austin Journal of Biosensors & Bioelectronics*. His current research interests include electrochemical environmental microsensors for biofilm and corrosion investigation, electrocoagulation for emulsion breaking, and greywater reuse.

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