Non-enzymatic amperometric sensor for ultra-trace determination of hydrogen peroxide

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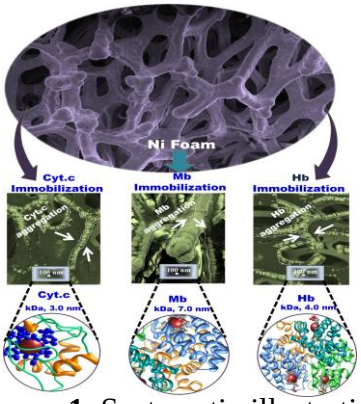
Sensing, environmental screening, and real time monitoring of biological molecules, toxic metals, and hazard materials at very low concentrations have gained considerable interest to date.[1] To control the high-performance niche in environmental monitoring of hazardous and biological species, development of chemical sensors for selective recognition and on-site monitoring potentiality of species has received growing demand worldwide.[2] Hydrogen peroxide (H_2O_2) is a reactive oxygen metabolic byproduct that functions as a key regulator for a number of oxidative stress-related states. Therefore, accurate, rapid, and low-cost monitoring of H_2O_2 is important in numerous fields. Here, we explored the effect of nano-object hemeproteins (denoted as N-HP) with various bio-functionalities on the electrochemical sensing performance of working electrodes toward H_2O_2 molecules by affecting interfacial electron transport and surface properties of N-HP (Scheme 1).[3] The electrocatalytic activities of the Ni foam electrodes modified with different N-HP (i.e., Hb, Mb, and Cyt.c) in the selective oxidation of H_2O_2 were investigated. Among the N-HP-modified Ni foam electrodes, Cyt.c modified Ni foam electrode showed the highest sensitivity with reduced hysteresis between cathodic and anodic sweep and low detection limit (Fig. 1). In addition, the N-HP-modified Ni foam electrodes exhibited no effects on major interferences, such as ascorbic, uric acids and dopamine (Fig. 2). Hence, immobilization of different N-HP with different bio-functionalities and sizes onto Ni foam electrodes may facilitate the design and fabrication of novel biosensors



Scheme 1. Systematic illustration of immobilization of nano-scale heme-proteins at the surface of Ni foam.

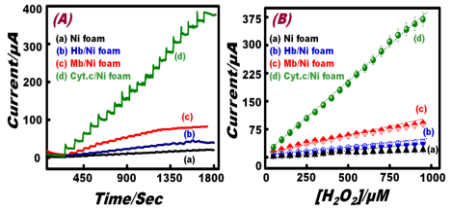


Figure 1 (A) Amperometric responses of the different working electrodes to successive addition of 5×10−5 M H_2O_2 to 0.1 M NaOH solution at 0.45 V (vs. Ag|AgCl). (B) Standard calibration graph derived from the current–

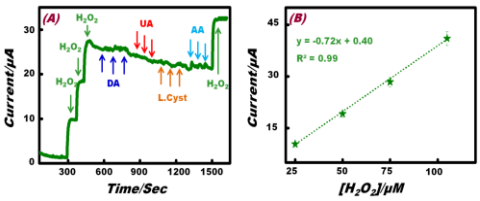


Figure 2 (A) Amperometric selective responses of the working electrodes to successive addition of H_2O_2 (0.25×10^{-4}M) and different interferences (5×10^{-4}M) at 0.45 V (vs. Ag|AgCl). (B) Standard calibration graph derived from the current–time plot.

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Reference:

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