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High Catalysis Activity of Cu₂O Microcrystals to the Electrochemiluminescence of Luminol and H₂O₂

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Cuprous oxide (Cu₂O) is a classical p-type semiconductor with a direct band gap of 2.17 eV, which is widely used for solar energy conversion, CO oxidation, and photo catalytic water splitting for the low cost and environmental friendliness.¹ For the energy band positions are favorable to the hydrogen evolution and oxygen evolution potentials, Cu₂O materials also catalyze the reduction of hydrogen peroxide (H₂O₂), which is an critical molecule in the bodies' metabolism processes or the industrial catalysis reactions.² To improve detection sensitivity of H₂O₂, people have composed Cu₂O materials with Ag nanoparticles or graphene nanosheets, which are sophisticated and cost.³ Herein, we use the electrochemiluminescence (ECL) method to improve the sensitivity of the reaction catalyzed by Cu₂O microcrystals. As shown by Figure 1A, the ECL reaction of H₂O₂ and luminol catalyzed by Cu₂O octahedra (Figure 1B) is strong at the potential of -0.2 V (vs. Ag/AgCl). And the corresponding current of the reaction is not obvious (Figure 1A, inset). We also check the effect of copper ions (Cu²⁺) to the ECL reaction, and there is much lower catalytic activity to the ECL reaction by Cu²⁺ ions. It indicates that Cu₂O semiconductor microcrystal possess the good catalytic performance to this ECL reaction, which is important to develop the high-efficient and low-cost biosensors.

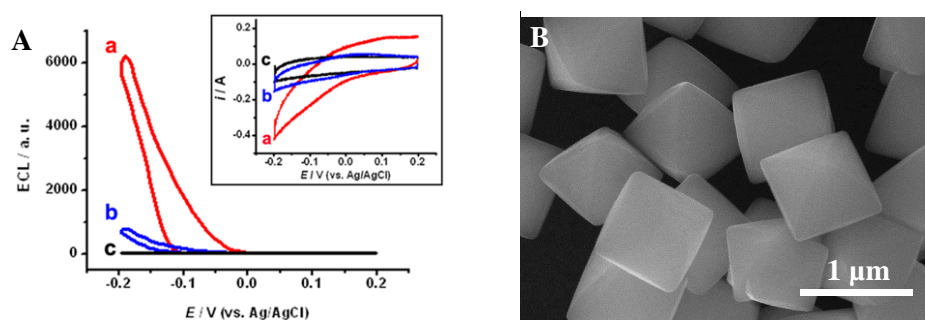


Figure 1. (A) ECL-potential curves of (a) 100 μM luminol and 100 μM H₂O₂ solution on the Cu₂O modified glassy carbon electrode (GCE), (b) 100 μM luminol, 100 μM H₂O₂, and 100 μM Cu²⁺ solution on GCE, and (c) 100 μM luminol and 100 μM H₂O₂ solution on GCE. Phosphate buffer, 50 mM, pH 7.4. Inset, corresponding cyclic voltammograms, scan rate. 50 mV·s⁻¹. (B) Scanning electronic microscopy image of octahedral Cu₂O microcrystals.

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