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Bimetallic Cu/Au Nanostructures and Bio-Application

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Abstract : Bimetallic nanostructures have received tremendous interests as a new class of nanomaterials which may have better technological usefulness with distinct properties from those of individual atoms and molecules or bulk matter. They excelled over the monometallic counterparts because of their improved electronic, optical and catalytic performances. The properties and the applicability of these bimetallic nanostructures not only depend on their size and shape, but also on the composition and their fine structure. These bimetallic nanostructures are potential candidates for bio-applications such as biosensing, bioimaging, biodiagnostics, drug delivery, targeted therapeutics, and tissue engineering. Herein, gold-incorporated copper (Cu/Au) nanostructures were synthesized through the controlled disproportionation of Cu^{+}-oleylamine complex at 220 ºC to form copper nanowires and the subsequent reaction with Au^{3+} at different temperatures of 140, 220 and 300 ºC. This is to achieve their synergistic effect through the combined use of the merits of low-cost transition and high-stability noble metals. Of these Cu/Au nanostructures, Cu/Au nanotubes display the best performance towards electrochemical non-enzymatic glucose sensing, originating from the high conductivity of gold and the high aspect ratio copper nanotubes with high surface area so as to optimise the electroactive sites and facilitate mass transport. In addition to high sensitivity and fast response, the Cu/Au nanotubes possess high selectivity against interferences from other potential interfering species and excellent reproducibility with long-term stability. By introducing gold into copper nanostructures at a low level of 3, 1 and 0.1 mol% relative to initial copper precursor, a significant electrocatalytic enhancement of the resulting bimetallic Cu/Au nanostructures starts to occur at 1 mol%. Overall, the present fabrication of stable Cu/Au nanostructures offers a promising low-cost platform for sensitive, selective, reproducible and reusable electrochemical sensing of glucose.

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