Electronic Supplementary Material (ESI) for Analytical Methods.

Pencil drawn microelectrode on paper and its application in two-electrode electrochemical sensors

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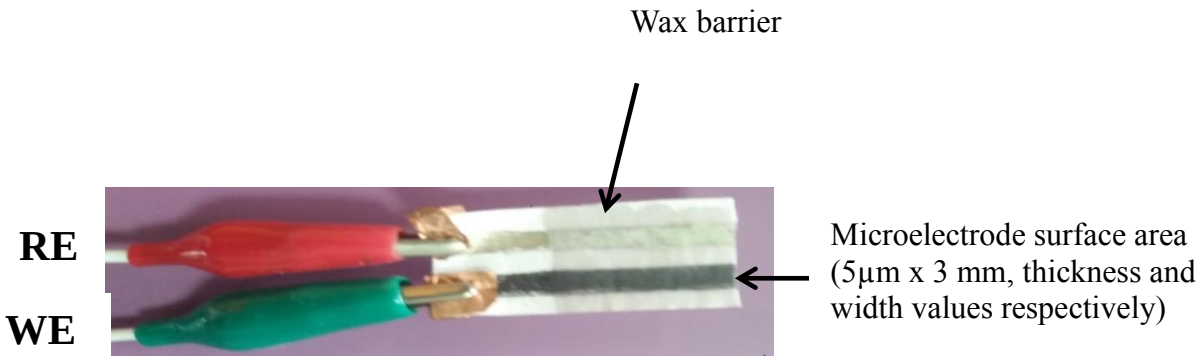

Scheme S1. A typical fabricated two electrode system microelectrodes. RE represent reference/counter electrode of silver adhesive paint, WE represent working electrode of graphite pencil traces on Whatman filter paper.

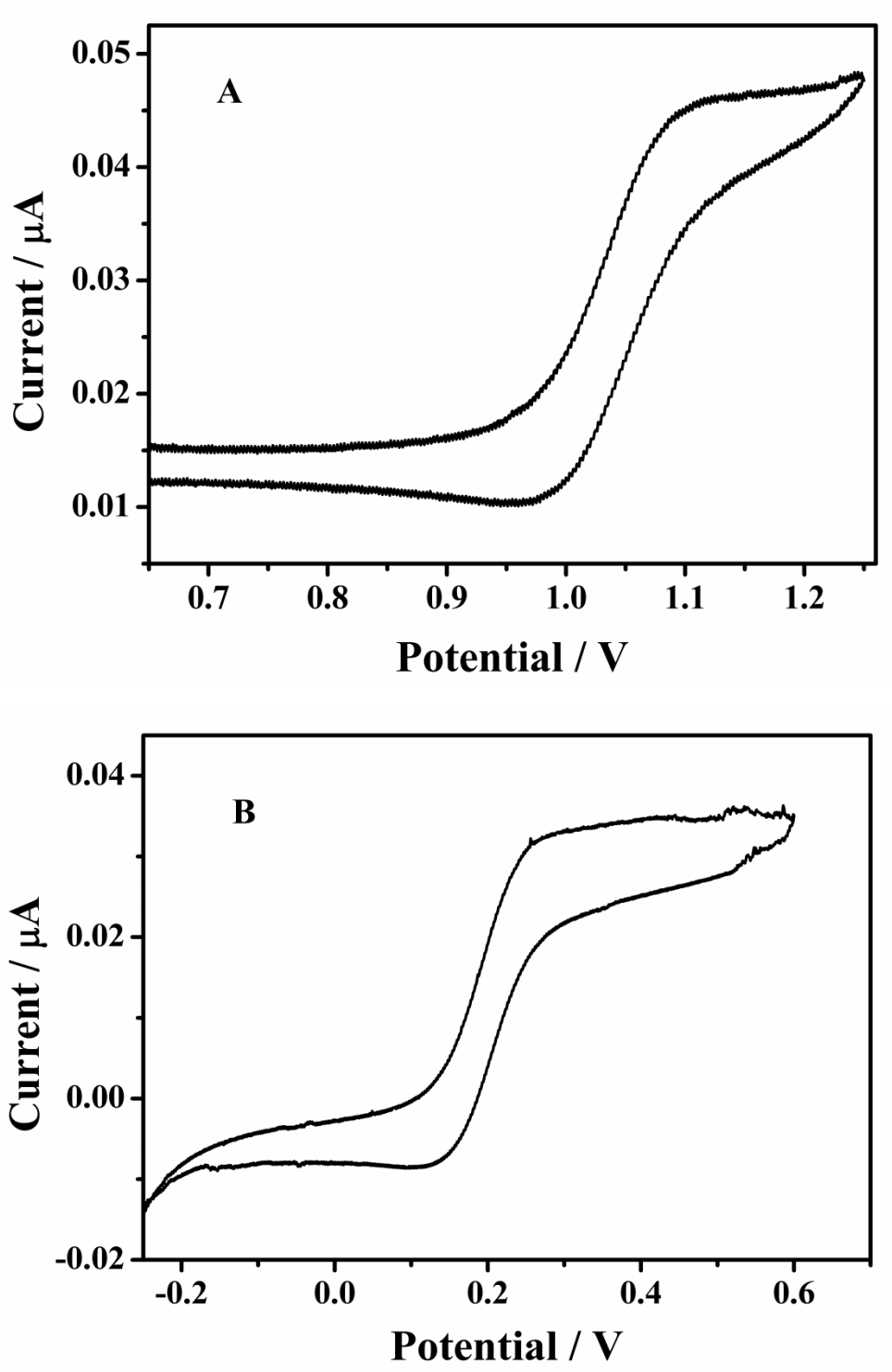

Figure S1. Cyclic voltammograms recorded for PDP microelectrode (A) in 1mM $Ru[(bpy)_3]^{2+}$ + 0.1 M KCl solution and PDP electro-deposited gold (B) in 1mM $Fe[(CN)_6]^{4-}$ + 0.1 M KCl solution. (scan rate = 30 mV/s).

The micro-behaviors of the proposed microelectrode was investigated by exploring the voltammetric responses using $Ru[(bpy)_3]^{2+}$ and $Fe[(CN)_6]^{4-}$ as redox probes. As shown in Fig. S1-A, when we used $Ru[(bpy)_3]^{2+}$ as redox probe. A well-defined, sigmoid-shaped voltammogram was achieved on PDP microelectrode, demonstrating that a nonlinear diffusion process was involved in the electrochemical process on the electrodes and thereby revealing the micro-sized property of the prepared PDP-modified microelectrode which in a good agreement with the literature data of microelectrodes behaviors[1] . Since current is proportional to electrode area, when the current is low (typically for nA or lower) there is the possibility to perform electrochemical measurements using two electrodes with no loss of current response[2].

Furthermore, this kind of microelectrode can be extending to microband such as gold (Au) or platinum (Pt) microband via electrodeposition. To investigate this, we have electro-deposited gold onto the PDP microelectrode surface. As shown in Fig. S1-B the CV response of modified PDP with Au in 1 mM ferrocyanide + 0.1 M KCl solution. Typical two sigmoidal voltammetric profiles recorded at PDP/Au microelectrodes where well-defined limiting currents are observed which are characteristic of radial diffusion (small electrode size) at potential between -0.2 and 0.6 V versus SCE, which also provided the proof of the micro-electrode behaviors [3, 4]. The CV curves are shaped differently at a microelectrode using the different redox probe ions, but current responses were much less than that of macro-electrode due to the smaller electrode area.

References

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