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**Supporting Information**

# Electrochemical sensor using poly-(L-cysteine) functionalized CuO nanoneedles/N-doped reduced graphene oxide for detection of lead ion

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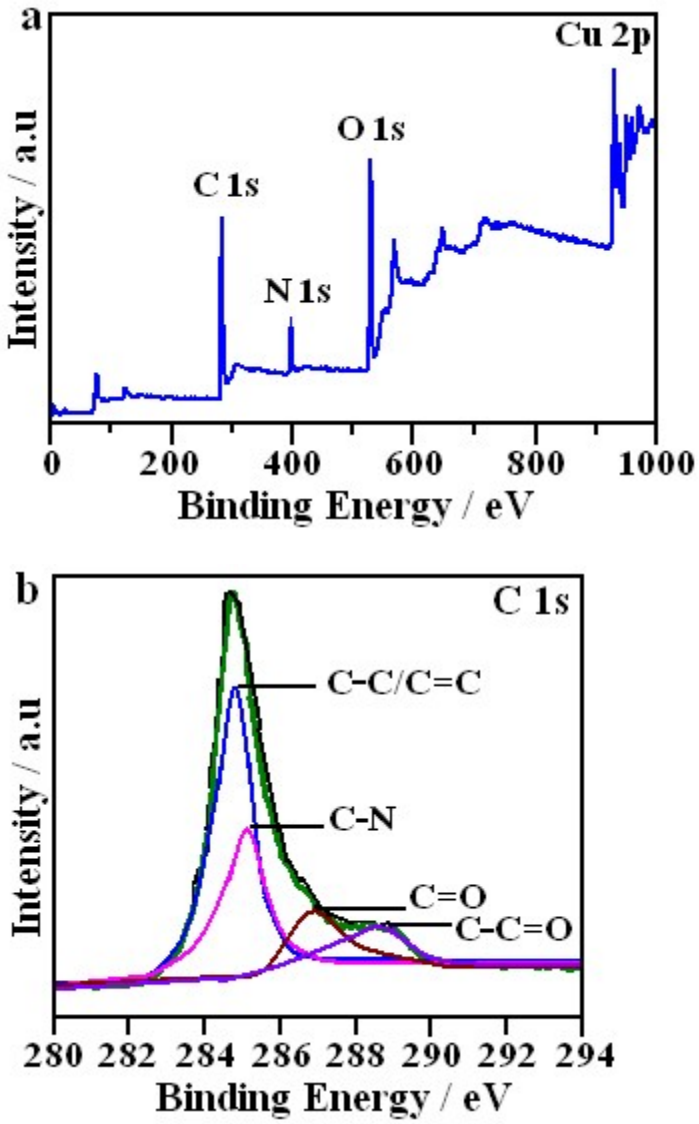
**Figure S1**


a
Cu 2p
O 1s
C 1s
N 1s
Intensity / a.u
0
200
400
600
800
1000
Binding Energy / eV
b
C 1s
C-C/C=C
C-N
C=O
C-C=O
Intensity / a.u
280
282
284
286
288
290
292
294
Binding Energy / eV

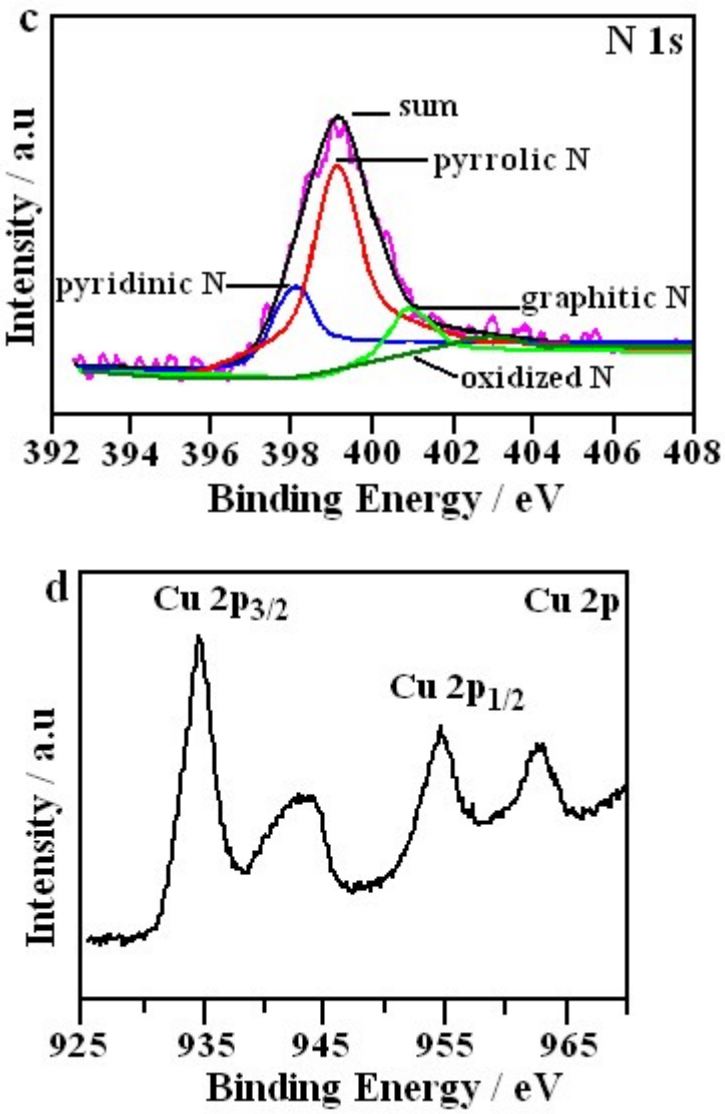



**Figure S1.** XPS spectra of NN-CuO/N-rGO (a) and its C 1s (b), N 1s (c) and Cu 2p (d) spectra.

Figure S1 shows XPS spectra of the nanocomposite. In the survey region (0−1000 eV) (Figure S1a), it clearly demonstrates the presence of C, O, and Cu elements in the sample. Figure S1b shows a high-resolution spectrum of C, it can be fitted into four peaks at 284.4, 285.4, 286.3 and 288.5eV, which are referred to C−C/C=C, C−N, C=O, and C−C=O vibrations, respectively [1]. One can see obviously that the peak intensity of C=O and C−C=O is much weaker than that of C−C, indicating that most of the oxygen-containing groups have been removed after hydrothermal treatment [2]. The high resolution N1s spectra (Figure S1c) for the nanocomposite shows four bands at 398.0, 398.8, 401.0 and 403.2 eV, corresponding to the pyridine-like structures N, pyrrolic or amine moieties N, graphitic N and weak oxidized N [3],

respectively. Notably, the amount of N incorporated in the nanocomposite was found to be approximately 6.94% with a high doping level. Figure S1d is the high-resolution spectrum of Cu element. The peaks observed at 934.6 and 954.5 eV are assigned to Cu 2p3/2 and Cu 2p1/2, which are attributed to oxidized Cu (II) [4]. Additionally, two satellite peaks at 943.7 and 962.7 eV, further confirm that the oxide in the sample are CuO [2], which reveals that the NN-CuO have formed in the nanocomposite.

**Figure S2**

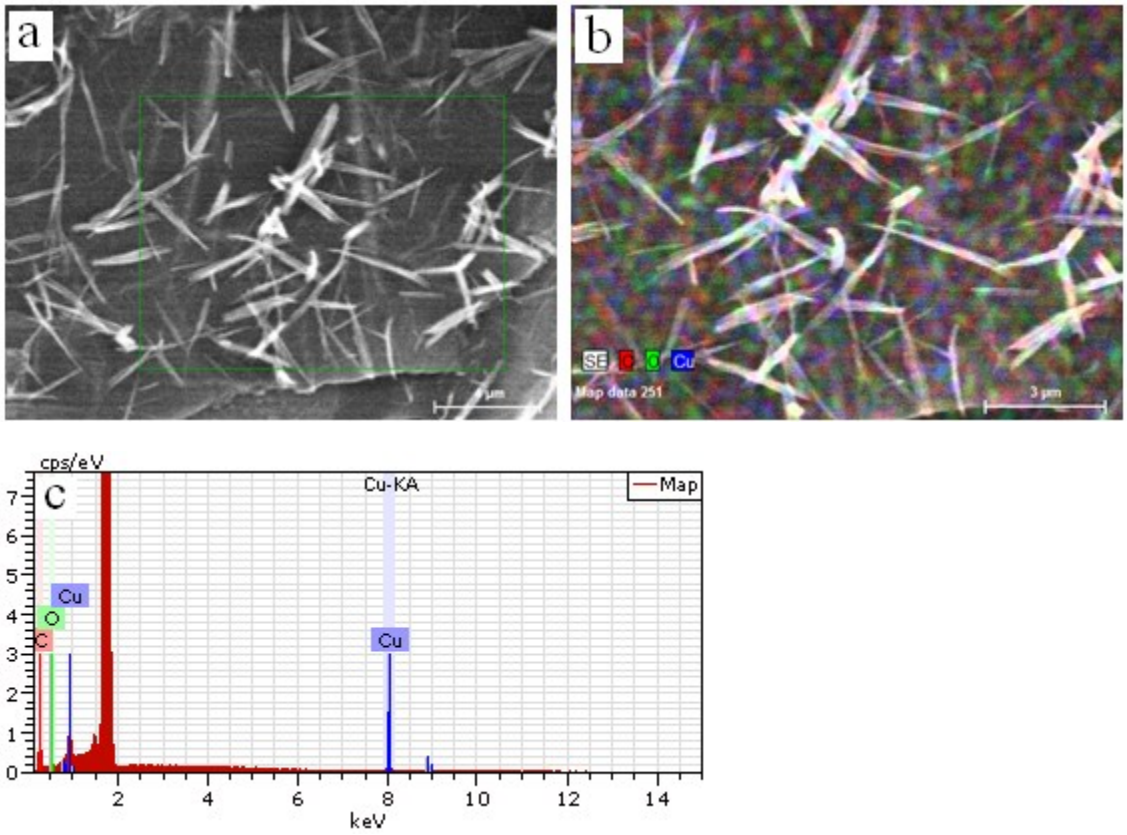



**Figure S2** EDS mapping images of NN-CuO/N-rGO.

From the EDS examination (Figure S2), the elemental composition was confirmed the presence of C, O and Cu elements which have an uniform distribution within nanocomposite.

References:

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[3] D. Long, W. Li, L. Ling, J. Miyawaki, I. Mochida, S.H. Yoon, Preparation of nitrogen-doped graphene sheets by a combined chemical and hydrothermal reduction of graphene oxide, Langmuir 26 (2010) 16096−16102.

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