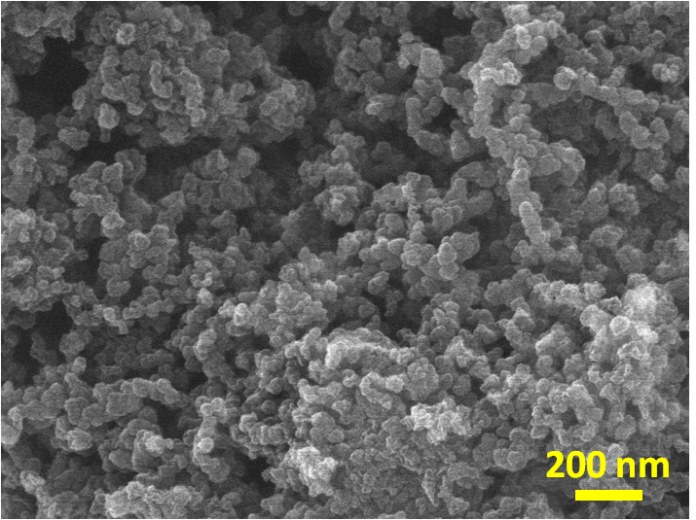
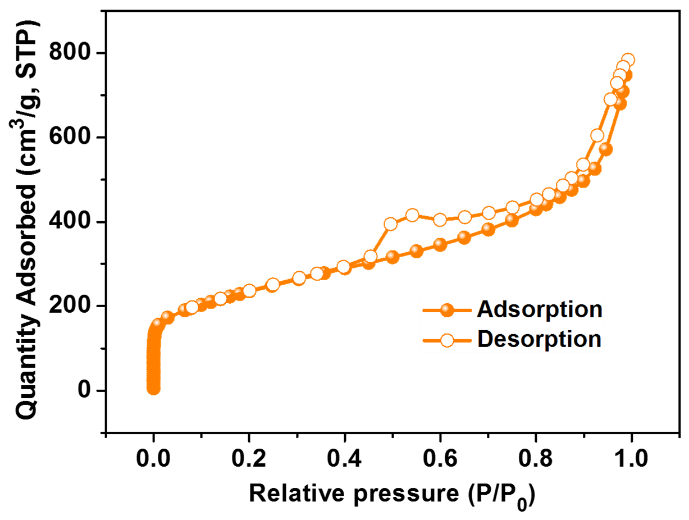
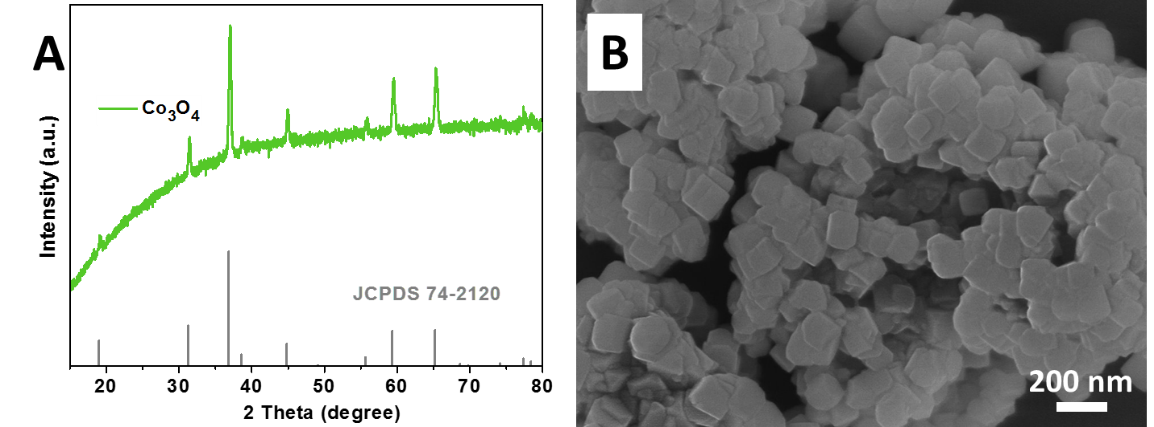
**Supplementary Material**

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**FIGURE S1** FESEM image of the N-KC sample.



**FIGURE S2** Nitrogen adsorption-desorption isotherm of Co3O4/N-KC sample.



**FIGURE S3** **(A)** XRD pattern and **(B)** FESEM image of the pure Co3O4 sample.

As shown in the XRD pattern (Figure S3A), all the typical diffraction peaks demonstrate that the Co3O4 structure with high purity is synthesized (cubic, Fd-3m, a = b = c = 8.084 Å, JCPDS: 742120). Figure S3B indicates the Co3O4 structure exhibits the shape of nanocube with an average particle size of ~ 85.3 nm.



**FIGURE S4** Co3O4/N-KC sample in O2-saturated KOH (0.1 M) with a scan rate of 5 mV s−1 at the different rotation speeds.

**Table S1** Parameters of ORR performance (*E*onset and Limiting current density) for previously reported non-noble metal samples measured in alkaline solution.

|  |  |  |  |
| --- | --- | --- | --- |
| Sample | *E*onset (V) | Limiting current density (mA cm-2) | Ref |
| Co3O4/N-KC | 0.87 | 5.70 | This work |
| CoIn2S4/S-rGO | 0.93 | ~ 5.57 | Fu et al., 2018 |
| Co/CoO/graphene | 0.87 | 4.53 | Guo et al., 2012 |
| Co3O4-NP/N-rGO | 0.89 | 5.48 | Han, et al., 2018 |
| NiO/MnO2@PANI | 0.92 | ~ 5.51 | He et al., 2017 |
| Co3O4/Co-N-C | 0.83 | 5.10 | Li et al., 2017 |
| N-Carbon/MnO2 | 0.88 | 5.57 | Li et al., 2018 |
| Co3O4/N-rmGO | 0.88 | 4.55 | Liang et al., 2011 |
| CoOx/C | 0.86 | 4.52 | Liu et al., 2014 |
| CaMnO3/S-300 | 0.92 | 5.52 | Peng. et al., 2018 |

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