## **Supporting Information**

## High-performance recyclable V-N-C catalysts for the direct hydroxylation of benzene to phenol using molecular oxygen

Sensen. Shang,<sup>ab</sup> Bo Chen,<sup>ab</sup> Lianyue Wang,<sup>a</sup> Wen Dai,<sup>a</sup> Yi Zhang<sup>a</sup> and Shuang Gao\*<sup>a</sup>

<sup>*a*</sup> Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian National Laboratory for Clean Energy, DNL, Dalian, 116023, People's Republic of China. E-mail: sgao@dicp.ac.cn; Fax: +086-0411-84379728; Tel: +086-0411-84379728.

<sup>b</sup> University of Chinese Academy of Sciences, Beijing, 10049, People's Republic of China.

\* Corresponding Author: Tel: 086-0411-84379728. Fax: 086-0411-84379728. E-mail: sgao@dicp.ac.cn.



Fig. S1 N<sub>2</sub> adsorption-desorption isotherms of V-N-C-600 catalyst.

| Table S1 Textural parameters of V-N-C catalysts. |                             |                  |
|--|-----------------------------|------------------|
| Sample   | $\mathbf{S}_{\mathrm{BET}}$ | Pore volume      |
|  | $(m^2g^{-1})$               | $(cm^{3}g^{-1})$ |
| V-N-C-400  | 29.974                      | 0.0953           |
| V-N-C-600  | 254.727                     | 0.2089           |
| V-N-C-800  | 392.324                     | 0.2666           |
| V-N-C-1000                                       | 544.681                     | 0.3946           |



Fig. S2 Ramman spectra of V-N-C catalysts.



Fig. S3 The surface morphology of V-N-C-600 catalyst.



**Fig. S4** SEM images of V-N-C-600 catalyst under UED (a) and BED-C (b) mode at 15.0keV. EDXS of V-N-C-600 catalyst (c). The particals were incorporated in the supports.



Fig. S5 (a) FT-IR spectra, (b) XRD patterns of fresh V-N-C-600 catalyst and catalyst after the sixth



Fig. S6 V XPS spectra of fresh V-N-C-600 catalyst(a) and catalyst after the sixth run of fresh(b).