# Supporting Information

# Nanodiamond/CNT-SiC Monolith as a Novel Metal Free Catalyst for Ethylbenzene Direct Dehydrogenation to Styrene

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**Experimental information:**

The SiC foam used as support was synthesized with a method of macromolecule pyrogenation combined with reaction bonding.[1] It has a honeycomb structure with high mechanical strength. The SiC foam was washcoated with a thin iron-containing coating by a simple method. In this method, a mixture solution was prepared by adding 2 g of $Fe(NO_3)_3 \cdot 9H_2O$, 4.7 g of $Al(NO_3)_3 \cdot 9H_2O$, and 6.4 g of $Mg(NO_3)_2 \cdot 6H_2O$, and 45 g of urea to 250 ml of deionized water in a flask. After mixed well, 10 g of SiC foam was added in this solution. The mixtures in the flask were continuously stirred at 90 $^oC$ for 10 h. After the mixture staying at 100 $^oC$ for 12 h without stirring, SiC foam was taken out following by a process of drying at 110 $^oC$ for 12 h, and finally the iron-containing wash coated SiC foam was obtained.

**Synthesis of CNT/SiC monolith:**

The iron-containing washcoated SiC foam was transferred to a quartz boat in a horizontal tubular furnace (supplied by Lindberg Blue M, HTF55342C) for CVD process. The furnace was heated under a flow of Ar (200 ml/min) at atmosphere pressure. When the reaction temperature reached 750 $^oC$, $H_2$ (40 ml/min) was introduced into the reactor for 5 min. A flow of $C_2H_4$ (80 ml/min) was then fed to grow CNTs for 30 min without changing the flow of $H_2$ and Ar. Then, the furnace

was cooled to room temperature under Ar. The obtained CNT/SiC products were saved for the support.

**Synthesis of UDD/CNT-SiC monolith:**

The commercial ND powders bought from Beijing Grish Hitech Co. (China) were dispersed into ethanol by sonication. Then the CNT/SiC monolith was soaked into the ethanol solution for 3 hrs. After that, the obtained samples were dried at 120 $^{o}$C overnight. The ND/CNT-SiC monolith with different weight loading can be synthesized by tuning the concentration of ND in the initial solution.

**Characterization and Catalytic performance test:**

The samples were characterized by SEM (Nova NanoSEM 450, FEI). The images of transmission electron microscopy (TEM) were observed on a Tecnai G2 F20 S-TWIN operated at 120 kV and a Philips CM200 FEG operated at 200 kV. Raman spectroscopy was tested by a LabRam HR 800 using a 632.8 nm laser. The catalytic tests were carried out for ND/CNT-SiC monolith (3.4% weight loading), CNT/SiC monolith and ND powders (diluted with quartz sands 3.4% weight loading) with the DH of ethylbenzene to styrene. The experiments were tested using 500 mg catalysts at 550 $^{o}$C in a fixed-bed quartz reactor. The mixture reactants were introduced to the reactor with a total flow rate of 10 ml/min (2.6% ethylbenzene) at atmospheric pressure for 20 h. The helium was used as a balance gas. The reaction product was analyzed by gas chromatography (Agilent 7890A) with FID and TCD.

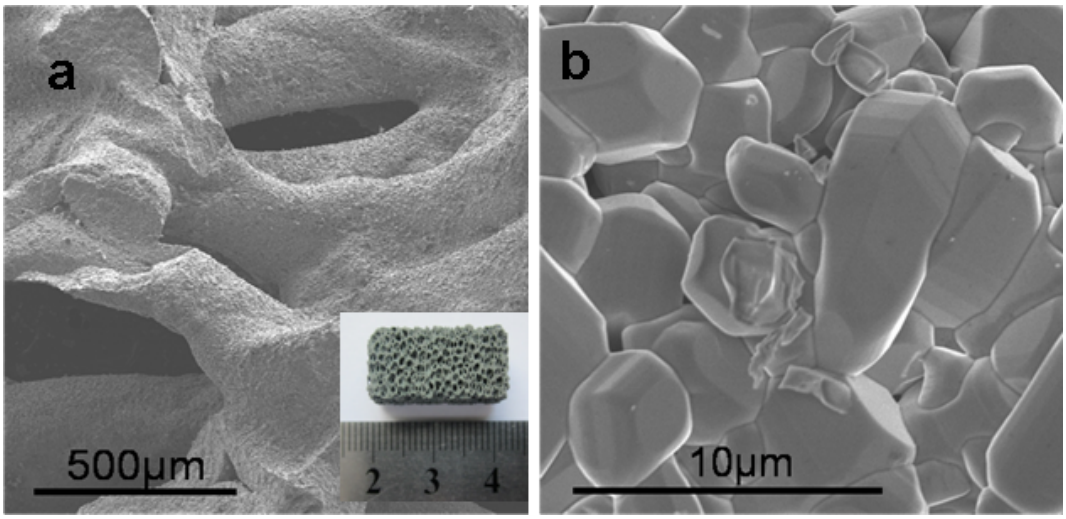


**Figure S1.** SEM images of the initial SiC foam. Inset is the photograph of initial SiC foam.

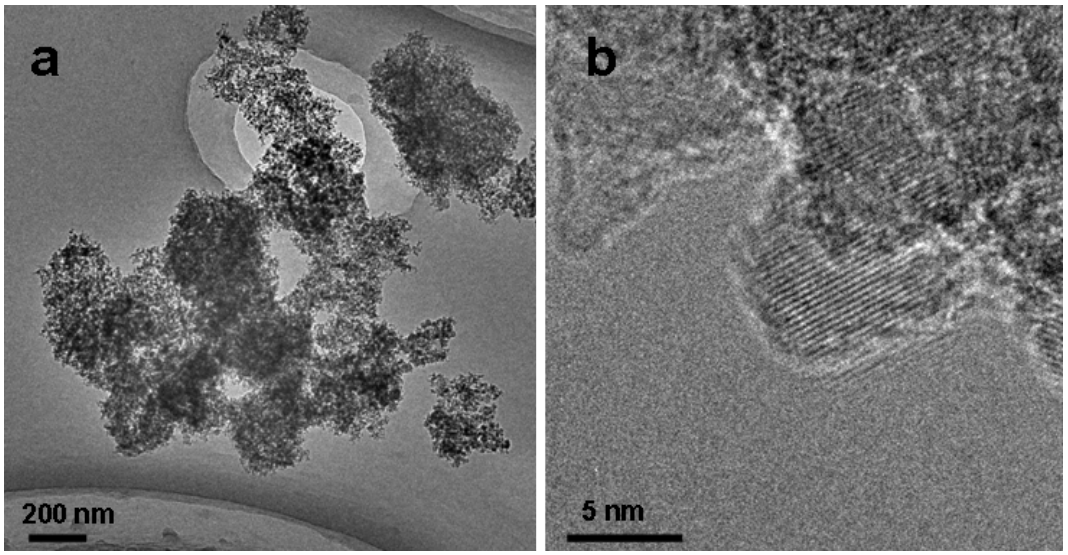


**Figure S2**. TEM images of the (a) commercial ND aggregates collected after sonicating in the ethanol and HRTEM image of (b) one ND nanoparticle.

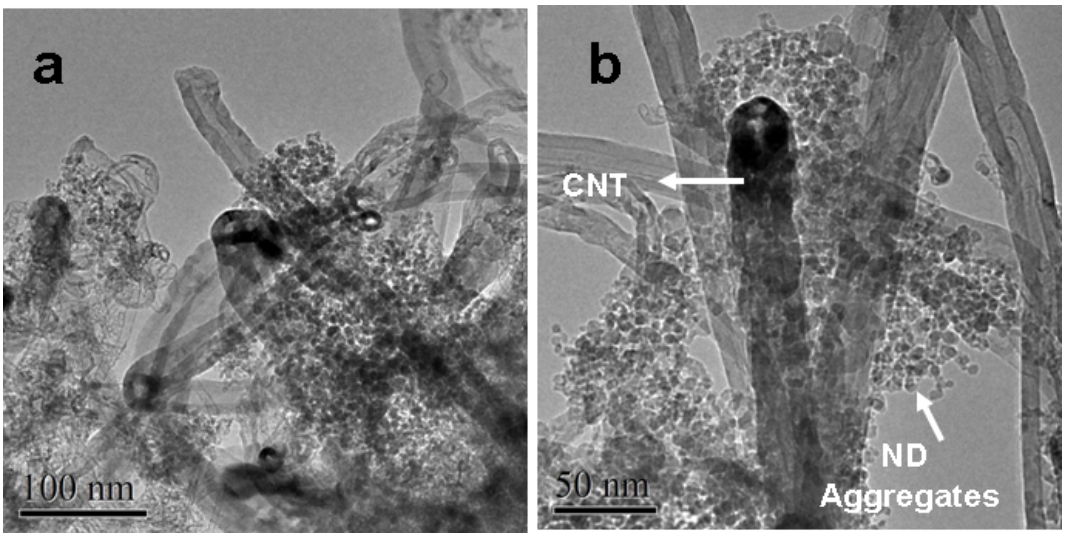


**Figure S3.** TEM images of ND/CNT-SiC monolith. The weight loading of ND is 1.2%.

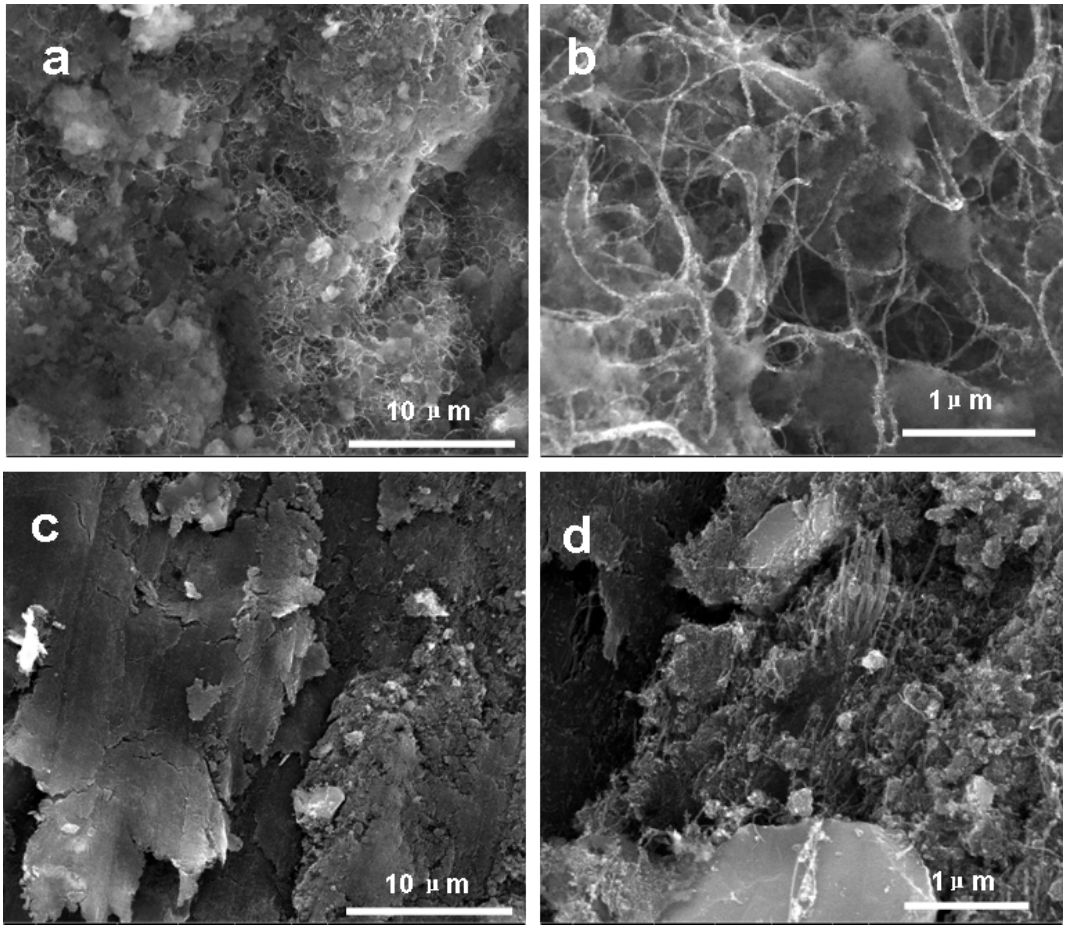


**Figure S4.** SEM images of ND/CNT-SiC monolith with different ND loadings: (a, b) 3.4% weight loading; (c, d) 6.2% weight loading.

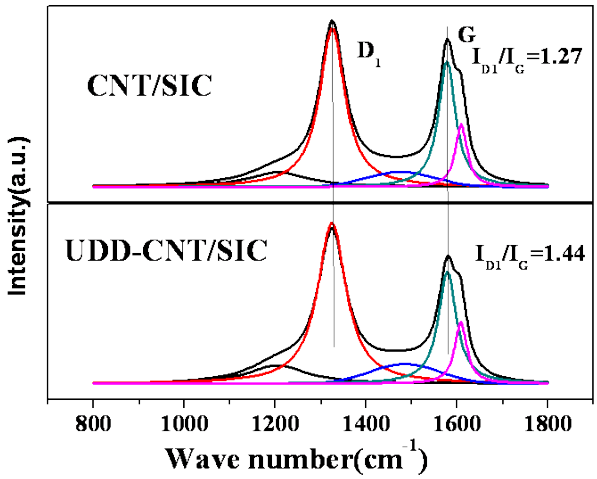


**Figure S5.** Raman spectra of CNT/SiC and ND/CNT-SiC monolith.

1 W. Wei, J. W. Li, H. T. Zhang, X. M. Cao, C. Tian, J. S. Zhang, *Scr. Mater.*, 2007, **57**, 1081-1084.