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Carbon nanotubes obtained from commercial resins with different treatment temperatures

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1. Synthesis of samples

The preparation of CNTs samples mainly consists of the following steps. Firstly, weigh 0.5 g potassium hexacyanocobaltate and dissolve it in 40 ml deionized water. After it is completely dissolved, add 3 g anion exchange resin(anion exchange resin 717) to the above solution and stir at room temperature for 6h. Wash the stirred solution with deionized water and dry it in an oven at 80°C for 12h. Then, the sample was placed in a tubular furnace in nitrogen atmosphere at a rate of 3 °C/min until the temperature rose to 800°C and maintained at 800°C for 5h. The other two samples were heated to 700°C and 900°C respectively, and other conditions were the same as above. The three samples treated at different temperatures are named CNTs-x (x=700, 800 and 900). Three carbon samples were prepared by directly calcining anion exchange resin in nitrogen atmosphere at 700°C, 800°C and 900°C for 5h at the same heating, these three samples were named C-x (x=700, 800 and 900).

The obtained CNTs samples were then treated with HNO₃ to remove cobalt. 65% HNO₃ solution was used, and 1g sample was treated with 150ml HNO₃. Condense and reflux at 140°C for 5 hours. After that, the acid treated samples were filtered and

dried in 80°C.

2. Catalyst characterization

X-ray diffraction (XRD)

The phase analysis of the samples was carried out by X-ray diffractometer (XRD, RIGAKU utima IV 2036e202 series X-ray diffractometer, Japan). Characterization conditions: Cu K α Ray ($\lambda= 1.54184 \text{ \AA}$), tube voltage 40 kV, tube current 40 mA, scanning angle 10-80 °, scanning speed 10 °/min.

N₂ adsorption desorption

The pore structure, pore volume and surface area of the samples were tested on micromeritics ASAP 2460 automatic specific surface analyzer (Mike company, USA). The specific surface area of the sample is calculated by Brunauer Emmett teller formula, and the pore volume is calculated by Barrett Joyner halide method.

Scanning electron microscope (SEM)

The SEM images of the samples were tested on the Hatachi S4800 scanning electron microscope (Hitachi, Japan).

Fourier transform infrared spectroscopy (FTIR)

The infrared spectrum of the sample was measured by the Fourier transform infrared spectrum of Bruker TYENSOR II (Bruker optics, Germany).

Raman spectra

The Raman spectra of the samples were characterized by 532 nm laser on LabRAM HR Evolution(HORIBA), and the graphitization degree of the samples was analyzed.