Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supplementary Information

Si-C-F Decorated Porous Carbon Materials: A New Class of Electrocatalyst for Oxygen Reduction Reaction.

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1. Experimental Section

1.1 Preparation of carbon materials

Si-C-F three dimensional porous carbon material (SIF-PCM)

In a typical experiment, D-Glucose (4 g), ammonium fluoride (8 g) and 4 g silicon dioxide (4 g, 50 nm) in silicon container was put in the furnace tube and heated at 800 ^{O}C, 900 ^{O}C and 1000 ^{O}C with the rate of 5 ^{O}C/min and maintained at the respective temperatures for one hour in argon atmosphere. And then the furnace tube was allowed to cool down to the room temperature. When the system was cold, the resulting sample donated as Si-C-F decorated three dimensional porous carbon material was collected from the silicon container and soaked in 10% HF or 1 M NaOH for 12 hours. The resulting precipitates were washed with double distilled water to get neutralized precipitates.

Carbon material with ammonium fluoride (F-PCM)

In this experiment, 4 g of D-Glucose and 8 g of ammonium fluoride was put in the furnace tube and heated at 900 ^{o}C in argon atmosphere and maintained at 900 ^{o}C with the heating rate of 5 ^{o}C/min, and the cooled down at room temperature.

Carbon material with silicon dioxide (SI-PCM)

4 g of D-Glucose and 4 g of silicon dioxide (50 nm) was put in the furnace tube and heated at 900 ^{o}C in argon atmosphere and maintained at 900 ^{o}C with the heating rate of 5 ^{o}C/min in silicon container, and the cooled down at room temperature.

Non-doped carbon material (UN-CM)

4 g of D-Glucose was put in the furnace tube and heated at 900 ^{o}C in argon atmosphere and maintained at 900 ^{o}C with the heating rate of 5 ^{o}C/min in silicon container, and the cooled down at room temperature.

1.2 Electrode preparation and electrochemical experiments

The pretreatment procedures of glass carbon electrode (5.0 mm in diameter) were as follows: prior to use, the electrodes were polished mechanically with aluminite powder on an abrasive paper to obtain a mirror-like surface, washed with ethanol and de-ionized water by sonication for 5 min and dried in a desiccator. 10 mg of each grinded sample was dispersed in 0.05 ml of solvent mixture of Nafion and 1.95 ml of Isopropanol by sonication. 4 µl suspension was dropped onto the glassy carbon electrode surface. And the electrode was dried at room temperature for 5 minutes before the electrochemical measurements.

1.3 Characterizations

The morphology of the catalytic materials was determined using a JEOL-6700 F scan electron microscope (SEM). Structure and electron distribution were characterized using transmission microscope (TEM, JEOL JEM-2010) with an acceleration voltage of 200 kV with a microanalyser with a resolution power of 129 eV. X-ray photoelectron spectroscopy (XPS, VG ESCLAB 250) was carried out on a 1487 eV X-ray photoelectron spectrometer using Al K_{α} radiation exciting source. The porous and textural properties of the materials were analyzed by nitrogen adsorption-desorption measurements by using an ASAP 2010 at 77 K. The specific surface area of the material was calculated using Brunauer-Emmett-Teller (BET)

equation. The pore size distributions (PSD) were acquired from the N_2 sorption isotherm based on. X-ray power diffraction (XRD) was performed with Philip X'Pert Pro MPP diffractometer using a Cu K_α (λ= 1.54 Å) radiation source.

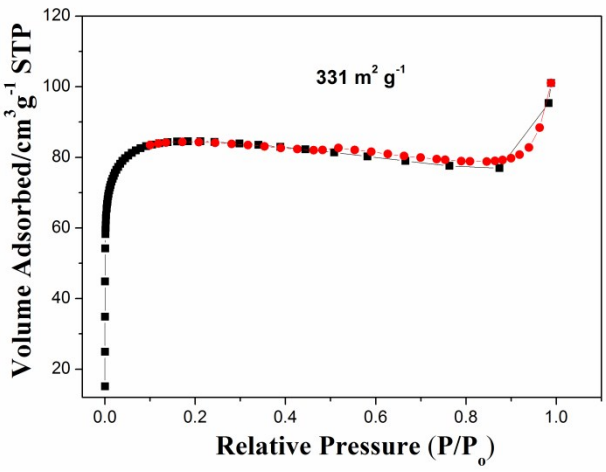

Figure S1. BET of F-PCM.

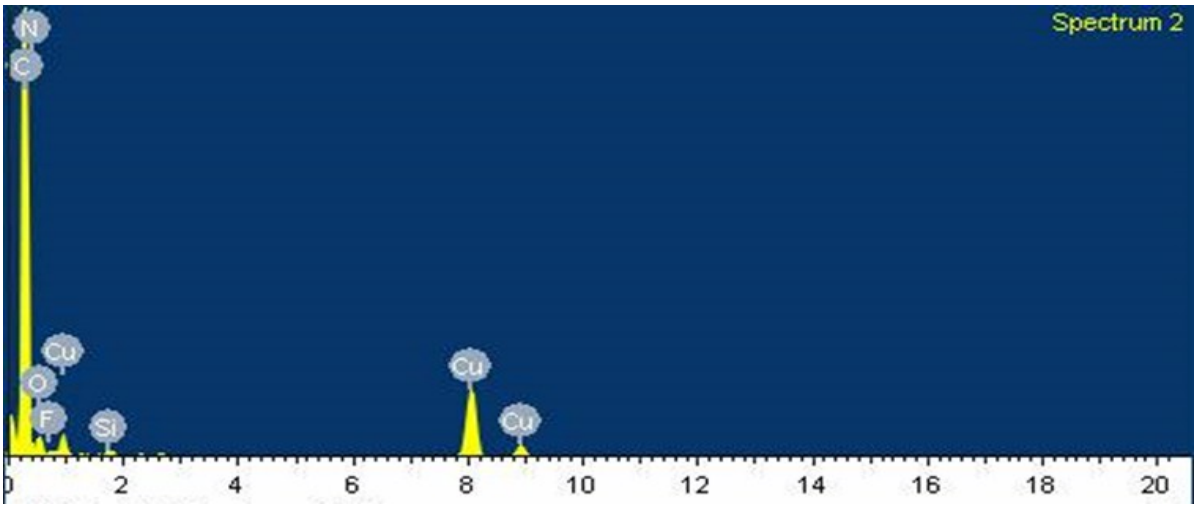

Figure S2. EDX Spectrum of SiF-PCM.

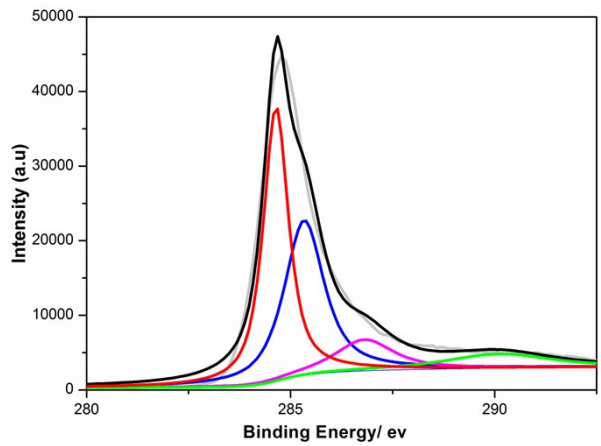

Figure S3. C 1s XPS spectrum of SiF-PCM

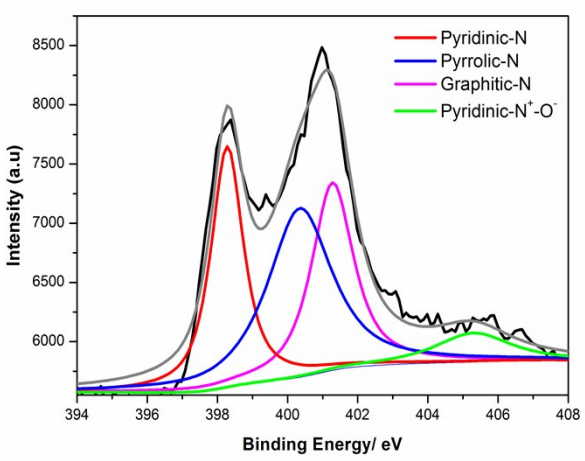

Figure S4. N 1s XPS spectrum of SiF-PCM

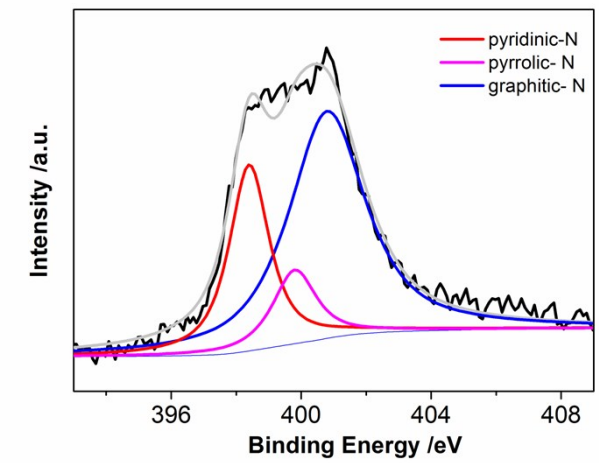

Figure S5. N 1s XPS spectrum of F-PCM.

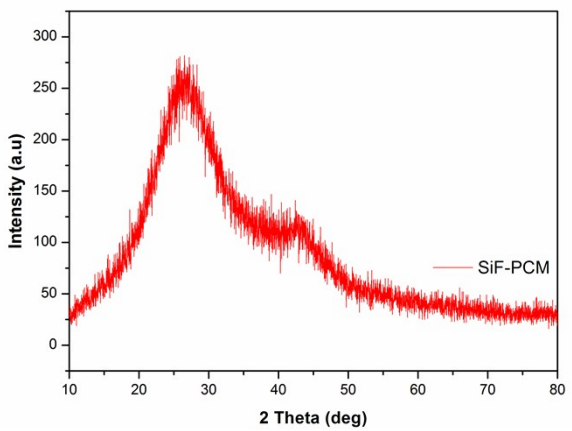

Figure S6. XRD spectrum of SiF-PCM.

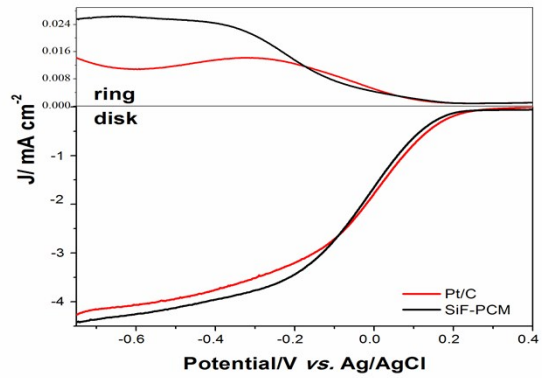

Figure S7. RRDE voltammograms of SiF-PCM in comparison with Pt/C.