Supporting information

2.3 Physicochemical characterization

The microstructures were analyzed by scanning electron microscope(SEM，MIRA3 LMH) transmission electron microscopy (TEM, Titan G2 60e300). X-ray diffraction (XRD) was carried out on Bruker Advance D8 X-ray diffractometer. Raman spectrum was performed on a Renishaw in Via spectrometer. The chemical states and element content were characterized by X-ray photoelectron spectroscopy (XPS, ESCA-LAB250X). The content of Pd and N was analyzed by the inductively coupled plasma (ICP 7000 SERIES).

2.4 Electrochemical measurements

The three-electrode electrochemical cell consisted of a Pt sheet (1 cm×1 cm), KCl sat. Ag/AgCl electrode and glassy carbon working electrode (GC, 5 mm in diameter, 0.196 cm^2). The glassy carbon working electrode was prepared as follows: 2 mg catalysts were taken into 500 μL water/ethanol/nafion (5 wt%) solution (volume ratios = 5:4:1). The solution was sonicated and 15 μL catalyst ink was dropped onto a polished GC electrode. Cyclic voltammograms (CVs) were measured in the potential ranging from -1.0 to 0.2 V in O_2 saturated 0.1 M KOH with a scan speed of 10 mV s^{-1}. The value of ECSA was calculated by the hydrogen adsorption charge in the region of 0 V to 0.4 V[12]. The ORR activities of catalysts were investigated by linear sweep voltammetry test at a rotation speed of 1600 rpm at a scan rate of 10 mV s^{-1}. The ADT was conducted by potential cycling between 0.6 and 1.0 V in O_2 saturated 0.1 M KOH with a scan rate of 50 mV s^{-1} to evaluate the durability of catalysts.

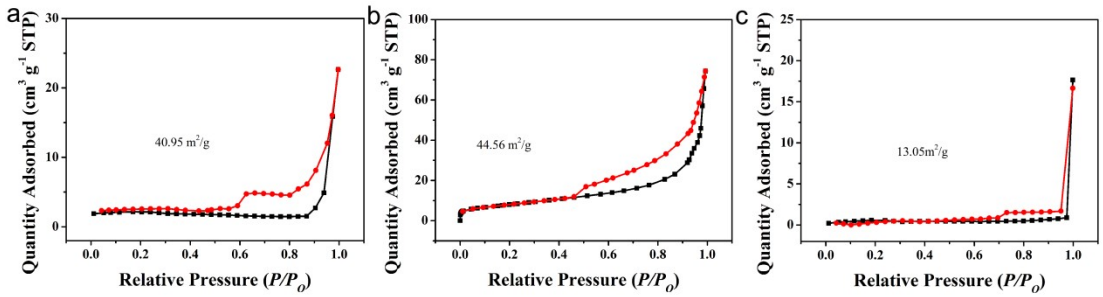

Fig.S1 The typical nitrogen adsorption-desorption isotherm of (a) Pd/$C_{0.05}$, (b) Pd/$C_{0.025}$ and (c) Pd/$C_{0.0125}$

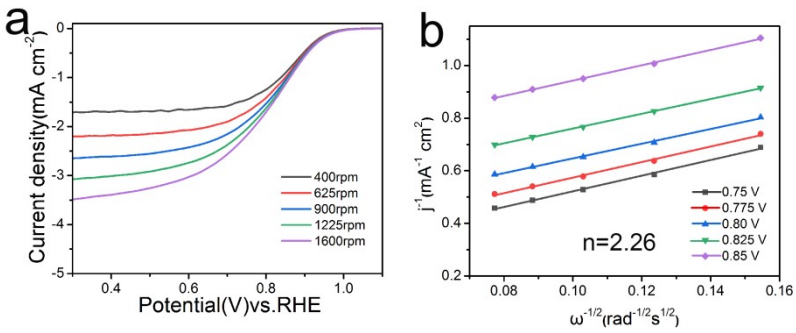

Fig.S2 (a)LSV and (b)Koutecky-Levich plots of Pd/C