Electronic Supplementary Information (ESI):

Influence of carbon pore size on the performance of Li-O_2 batteries

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Method of synthesis of RuO_2/PC100: In a typical synthesis of RuO_2/PC catalyst, ruthenium(III)-2,4-pentanedionate and PC100 were mixed in a weight ratio of 1:1 in acetone (10 ml), followed by vacuum drying at room temperature. The composite was then transferred in a tube furnace and sintered at 400 °C under Ar atmosphere for 3 h. The obtained sample was treated at 120 °C in oven for 24 h before electrode preparation.

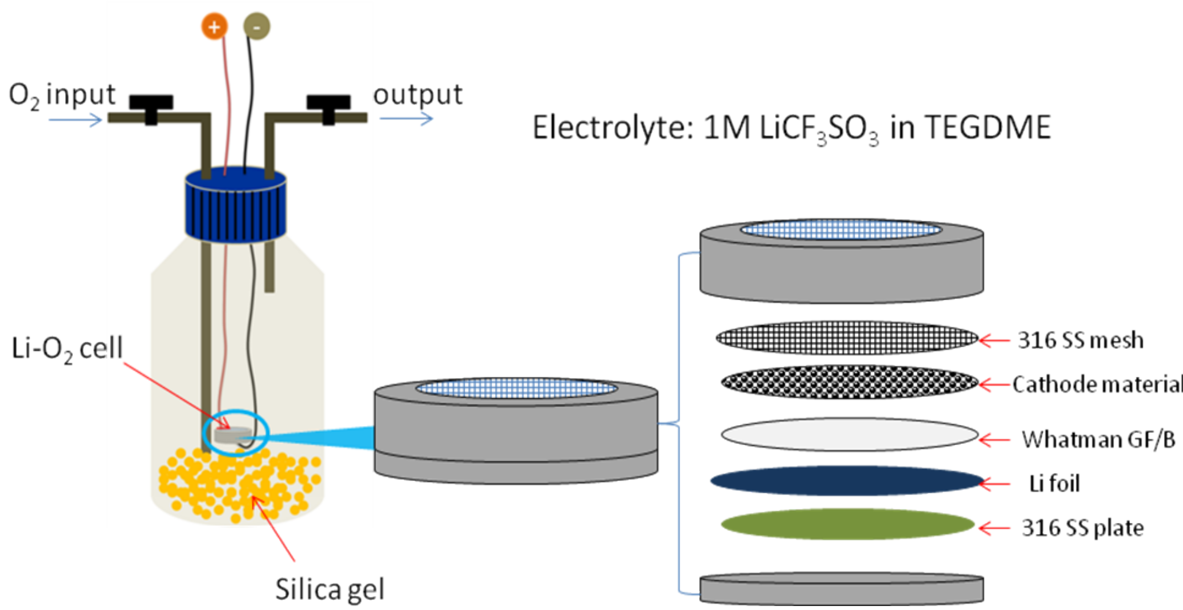

Fig. S1 Schematic drawing of the testing system of Li-O_2 battery.

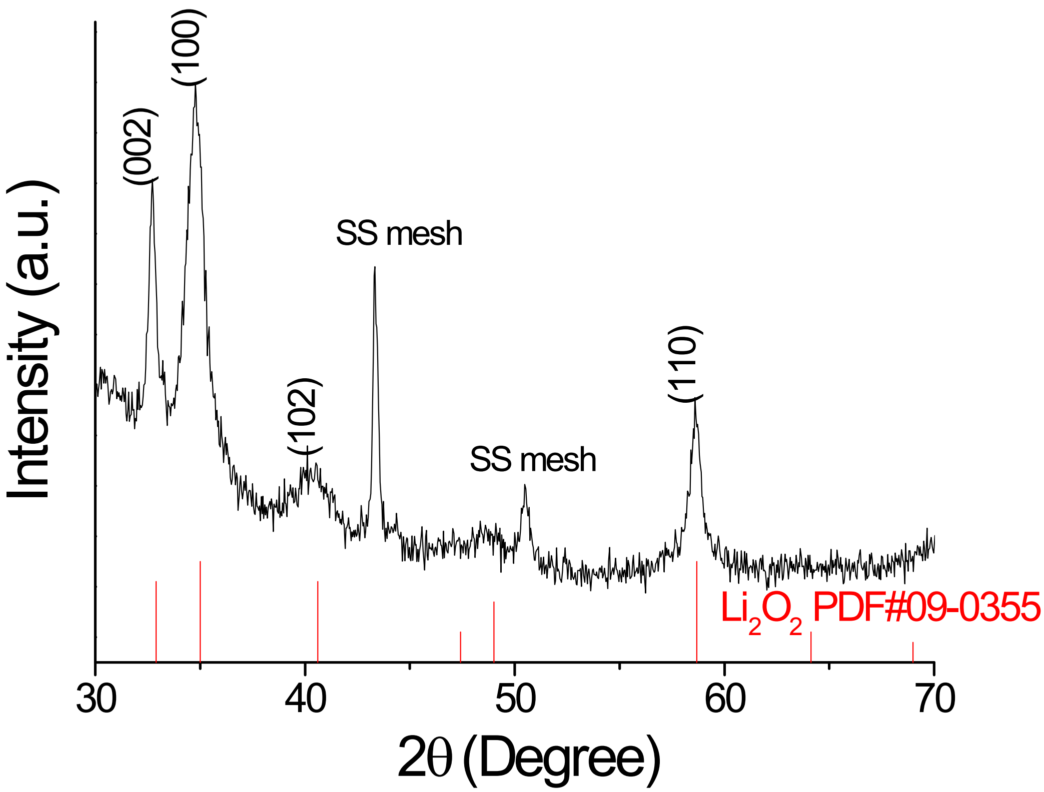

Fig. S2 XRD pattern of the carbon substrate (PC100) discharged to 2 V in 1 M LiTFS-TEGDME electrolyte.

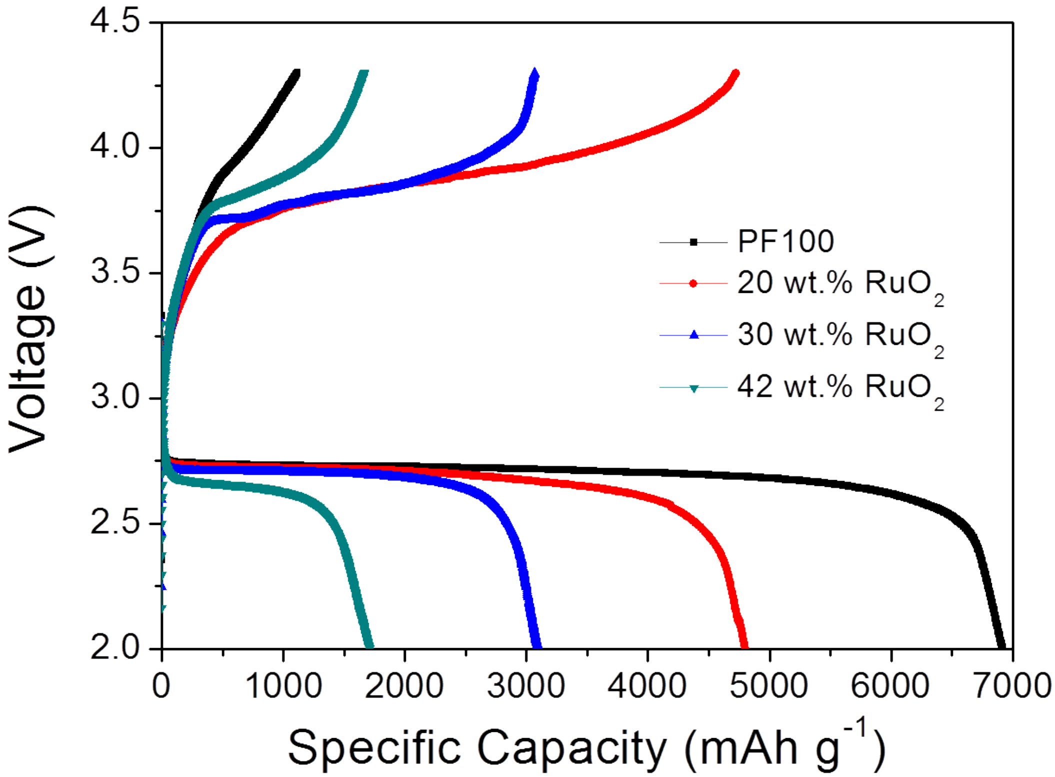

Fig. S3 Initial charge-discharge voltage profiles of PC100 decorated with different amount of RuO_2 at a constant current of 0.1 mA (100 mA g_c^{-1}).

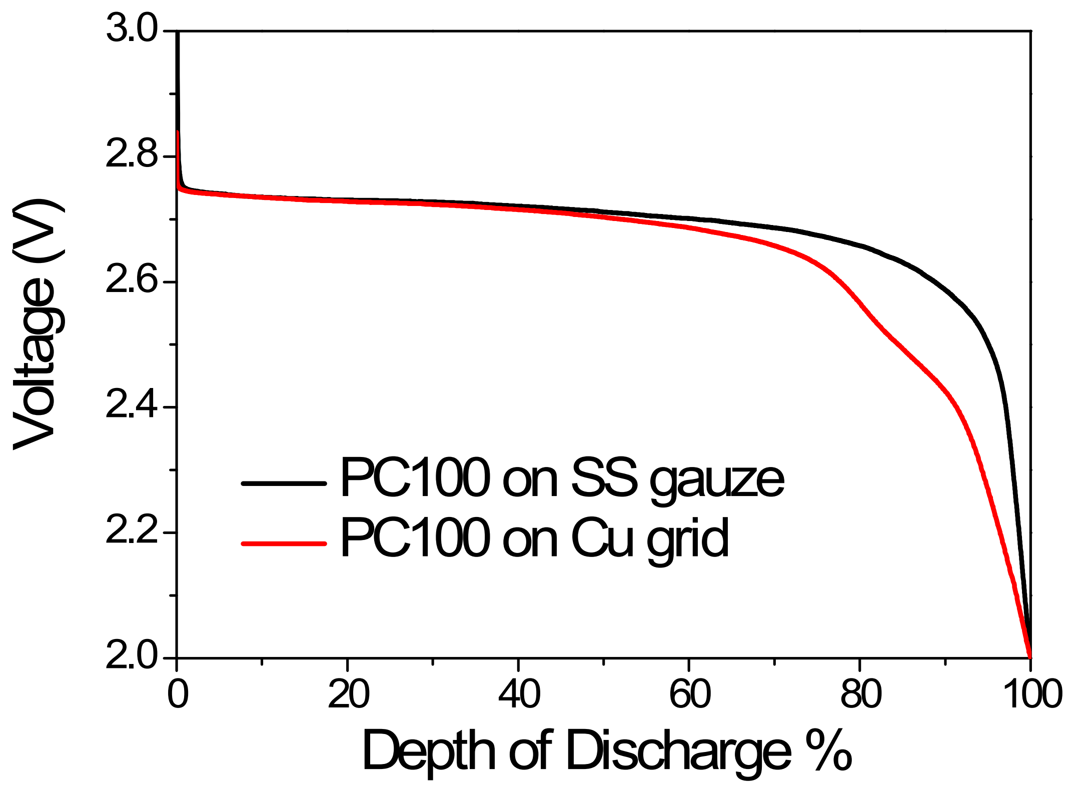

Fig. S4 Discharge voltage profiles (vs. depth of discharge, DOD) of PC100 loaded on SS gauze and on Cu grid.

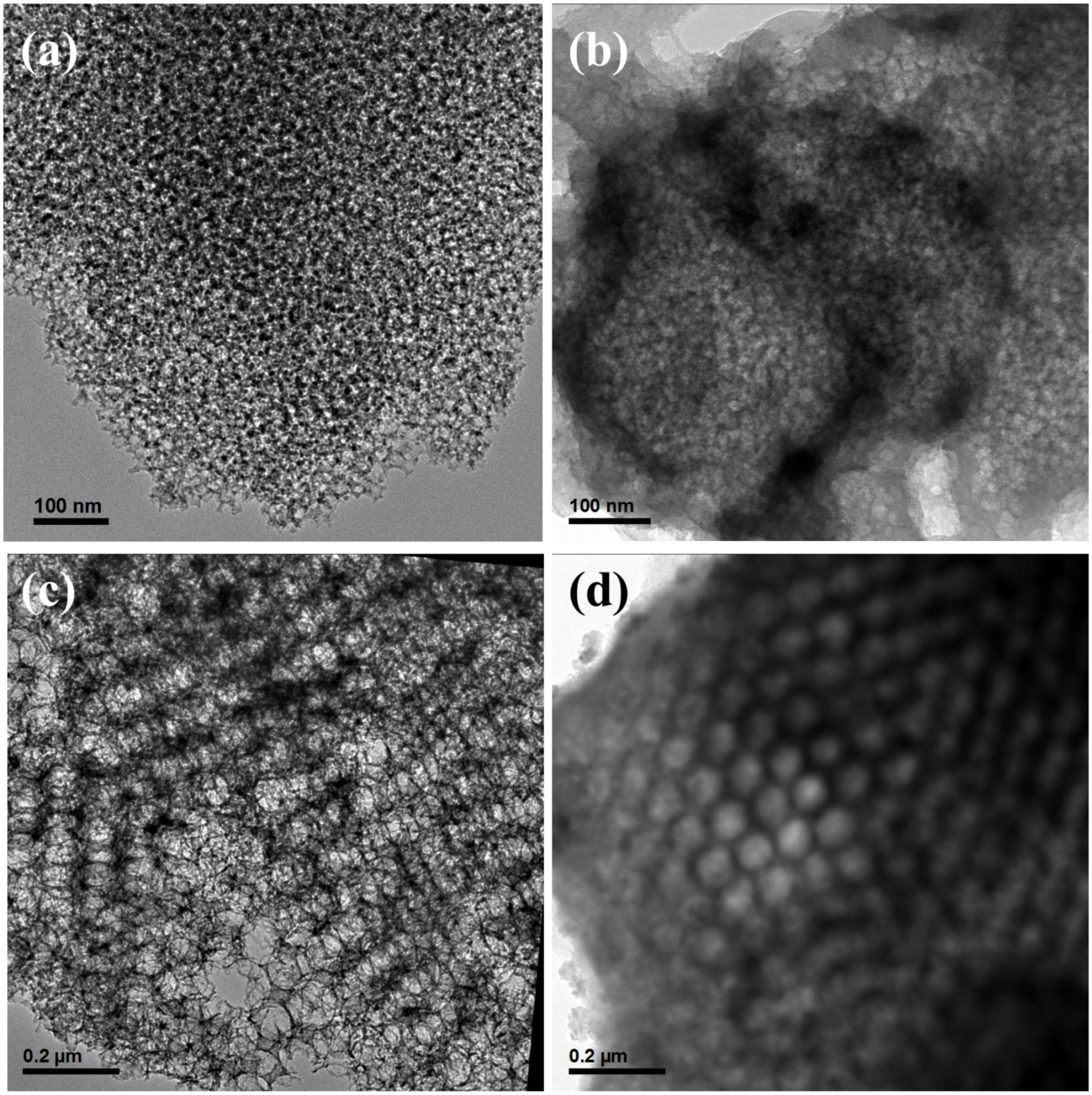

Fig. S5 TEM images of the porous carbons: (a) pristine PC20, (b) discharged PC20, (c) pristine PC100 and (d) discharged PC100. The cells were discharged to 2 V at a constant current of 2.0 μA.

Theoretical calculation of cell capacity of Li-O_2 batteries

The carbon yield from PF resin is 30%, thus the carbonized silica/carbon composite consists of 5 g silica and 0.165 g carbon (1.1 ml of PF resin solution with a concentration of 0.5 g mL^{-1}).

Weight of silica (W_{silica}) is 5 g.

Weight of carbon (W_{carbon}) is 0.165 g.

Density of silica (ρ_{silica}) is 2.648 g cm^{-3}.

Density of Li_2O_2 (ρ_{Li2O2}) is 1.2063 g cm^{-3}.

Molar mass of Li_2O_2 (M_{Li2O2}) is 45.88 g mol^{-1}.

N_A: Avogadro constant

Δ: constant value to convert the unit of A·s to mAh

D: Carbon pore size

Model A: all voids left by silica in porous carbon were occupied by Li_2O_2 during discharge

Weight of Li_2O_2: $W_{Li2O2}{}^{A} = (W_{silica}/\rho_{silica})\times\rho_{Li2O2}$

Theoretical capacity ($Q_T{}^{A}$) = $(W_{Li2O2}{}^{A}/M_{Li2O2}\times N_A\times 2)\times\Delta/W_{carbon}$ =16128 (mAh g^{-1}), which is irrelevant to carbon pore size.

Model B: A monolayer of Li_2O_2 with a thickness of 7.8 nm forms inside carbon pores.

Weight of Li_2O_2: $W_{Li2O2}{}^{B} = (W_{silica}/\rho_{silica})\times\rho_{Li2O2}\times[1-(1-7.8\times 2/D)^3]$

Theoretical capacity ($Q_T{}^{B}$) = $(W_{Li2O2}{}^{B}/M_{Li2O2}\times N_A)\times\Delta/W_{carbon}$ $=16128\times[1-(1-7.8\times 2/D)^3]$ (mAh g^{-1}), which decreases with the increase of carbon pores.