Supporting Information

Fabrication of highly monodisperse and small-grain platinum hole–cylinder nanoparticles as a cathode catalyst for Li–O_2 batteries

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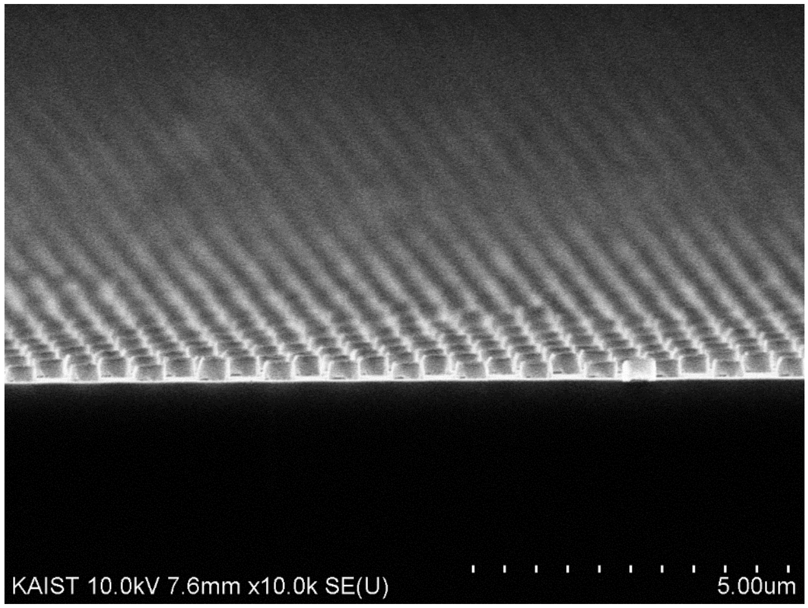
Morphology analysis of Pt hole–cylindrical nanopatterns



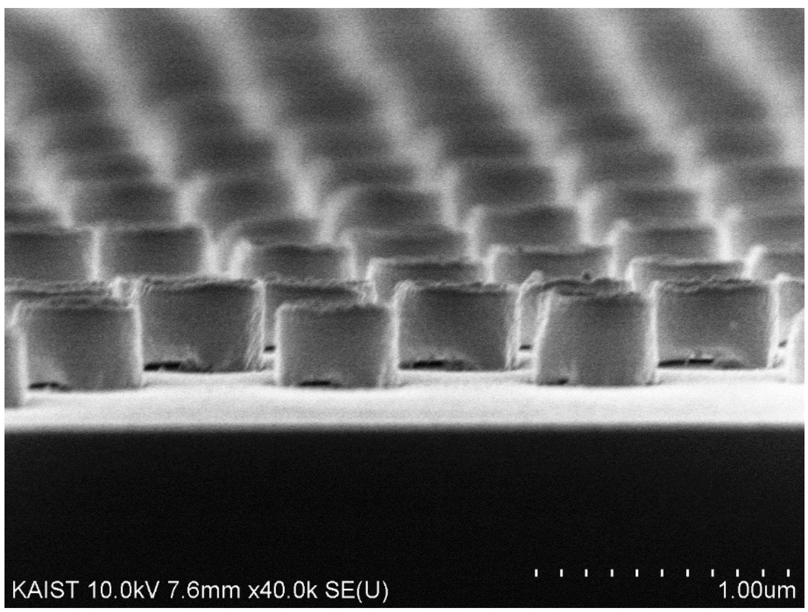


Figure S1: Low magnification and high magnification SEM image of Pt hole-cylindrical nanopattern fabricated over a large area from the side view.

TEM images and EDS line profile of GNP and Pt hole-cylinder nanoparticles

Figure S2 shows the Pt catalyst of the hole-cylinder morphology, and it can be seen that the Pt-hole-cylinder nanoparticles are well attached to the catalyst support GNP.

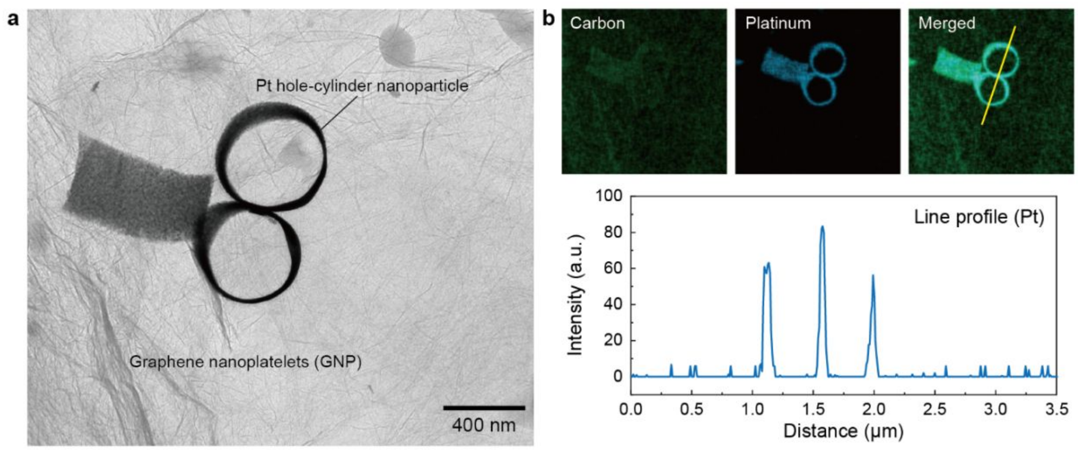


Figure S2: (a) TEM images of GNP and Pt hole-cylinder nanoparticles. **(b)** TEM-EDS mapping images and line profile of GNP and Pt hole-cylinder nanoparticles.

Electrochemical performance of electrodes in discharge/charge profile at first-cycle

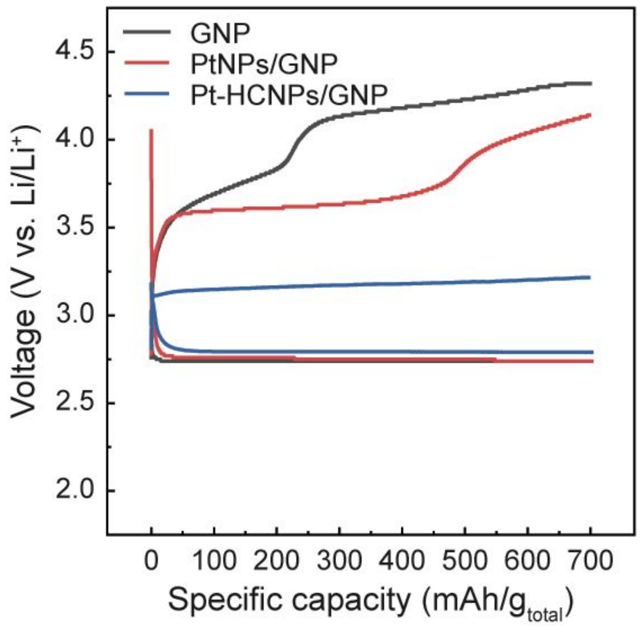


Figure S3: First-cycle discharge/charge profile of Li–O_2 cells with GNP, PtNPs/GNP, and Pt-HCNPs/GNP electrodes under a 70 mA g^{-1} to capacity of 700 mAh g^{-1}.

Electrochemical performance of electrodes in discharge/charge profile at the selected cycles

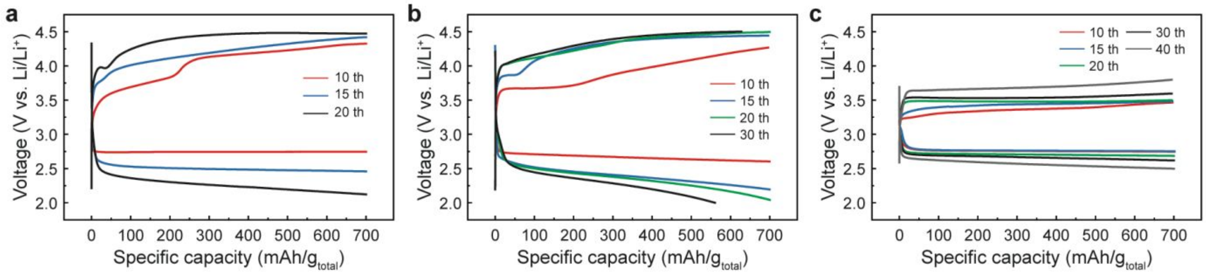


Figure S4: Discharge/charge profile of Li–O_2 cells at the selected cycles with (a) GNP, (b) PtNPs/GNP, and (c) Pt-HCNPs/GNP electrodes under a 70 mA g^{-1} to capacity of 700 mAh g^{-1}.

The specific capacity of the electrodes

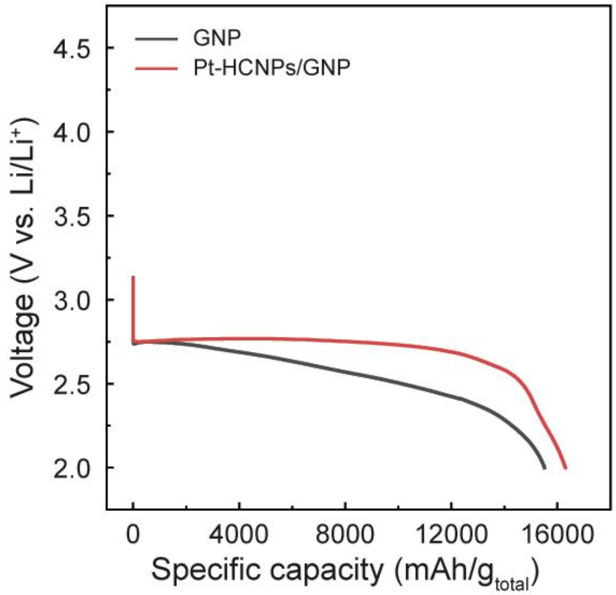


Figure S5: The full discharge profiles of GNP and Pt-HCNPs/GNP electrodes under a 100 mA g^{-1} to 2.0 V.

Morphology of discharge product

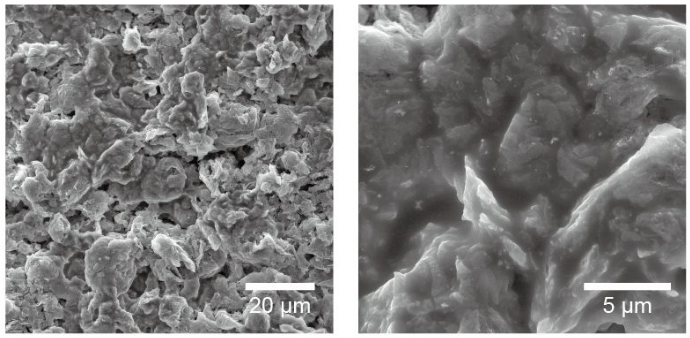


Figure S6: SEM images of PtNPs/GNP after discharge

Discharge product analysis

In **Figure S7**, the peak of crystalline Li_2O_2 can be seen in the XRD pattern of the discharged GNP electrode, whereas in the case of the XRD pattern of the discharged Pt-HCNPs/GNP electrode, the peak of crystalline Li_2O_2 cannot be seen.

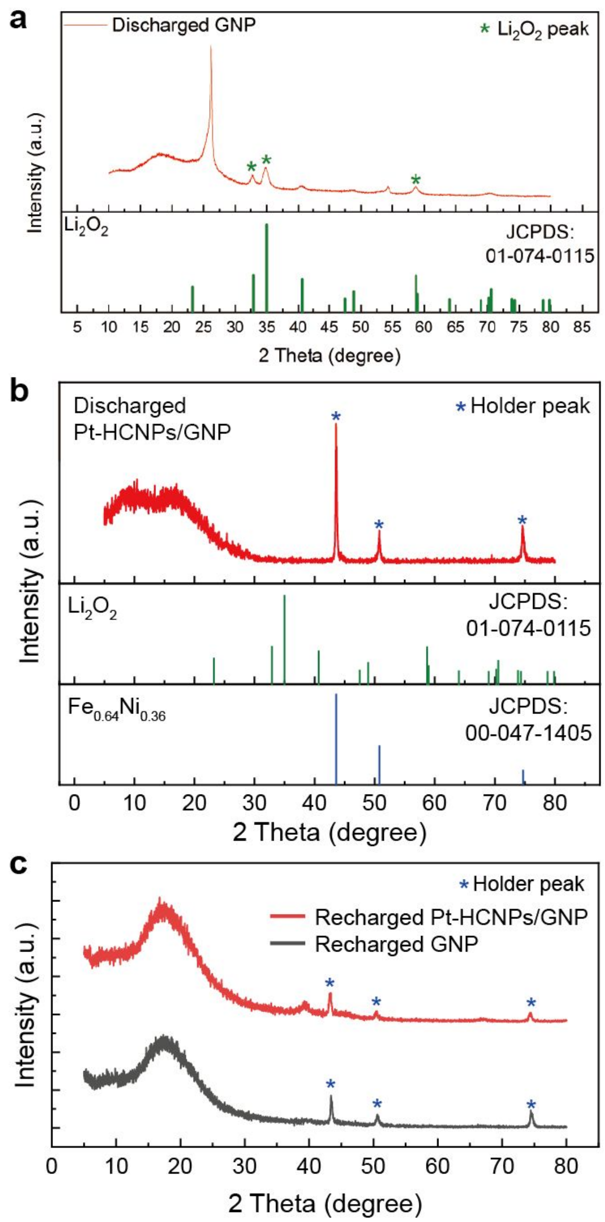


Figure S7: XRD pattern of (a) GNP electrode after discharge **(b)** Pt-HCNPs/GNP electrode after discharge **(c)** GNP and Pt-HCNPs/GNP electrodes after recharge

Pristine and recharged cathode analysis

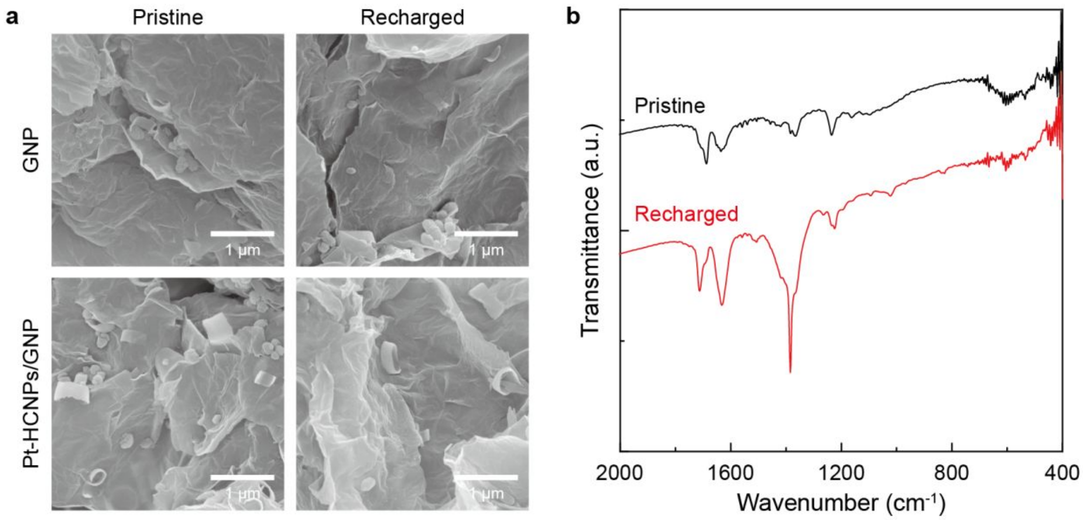


Figure S8: Pristine and recharged cathodes (a) SEM images of GNP and Pt-HCNPs/GNP **(b)** IR spectra of Pt-HCNPs/GNP.

Overpotential comparison

Table S1. Comparison of overpotential of Pt-HCNPs/GNP cathode with other reported Pt-based catalysts

Cathode	Electrolyte	Current density (mA g^{-1})	Overpotential (V *vs.* Li/Li^+)	Ref
Pt-HCNPs/GNP	1M $LiNO_3$ in DMA	100	0.41 V	**This work**
CNF@Pt	1M $LiNO_3$ in DMA	500	0.9 V	*Carbon* **2018**, *130*, 94-104
Pt/CNTs/Ni foam	1M LiTFSI in TEGDME	160	1.1 V	*ACS Appl. Mater. Interfaces* **2014**, *6*, 15, 12479–12485
Pt/α-MnO_2 nanotube	1M $LiClO_4$ in DMSO	70	1.07 V	*Nano Energy* **2014**, *10*, 19-27
Pt-Cu core-shell on carbon	1M $LiCF_3SO_3$ in TEGDME	100	0.5 V	*Nano Lett.* **2016**, *16*, 781-785
Pt-coated BND-Co@Graphene	1M $LiCF_3SO_3$ in TEGDME	100	0.88 V	*Adv. Energy Mater..* **2019**, *9*, 1900662
Pt bulk-doped BND-Co@Graphene	1M $LiCF_3SO_3$ in TEGDME	100	0.55 V	*Adv. Energy Mater..* **2019**, *9*, 1900662