# Supporting Information

# Functionalization of Hierarchical Porous Carbon Materials for Adsorption of Light Rare Earth Ions

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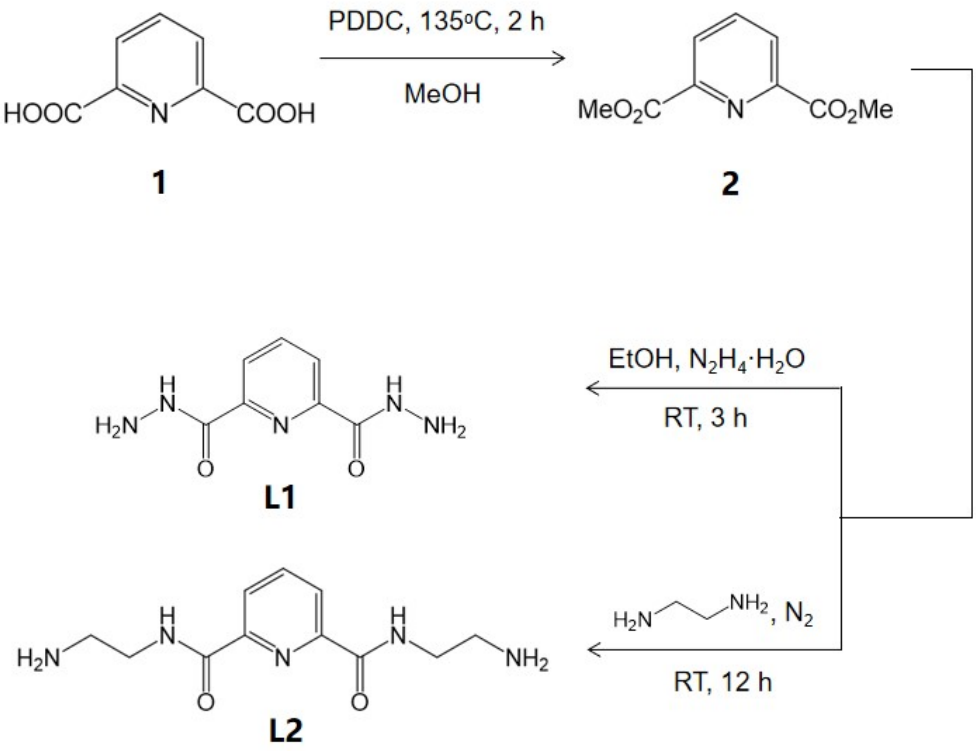


**Figure S1.** Schematic representation of ligand synthesis.

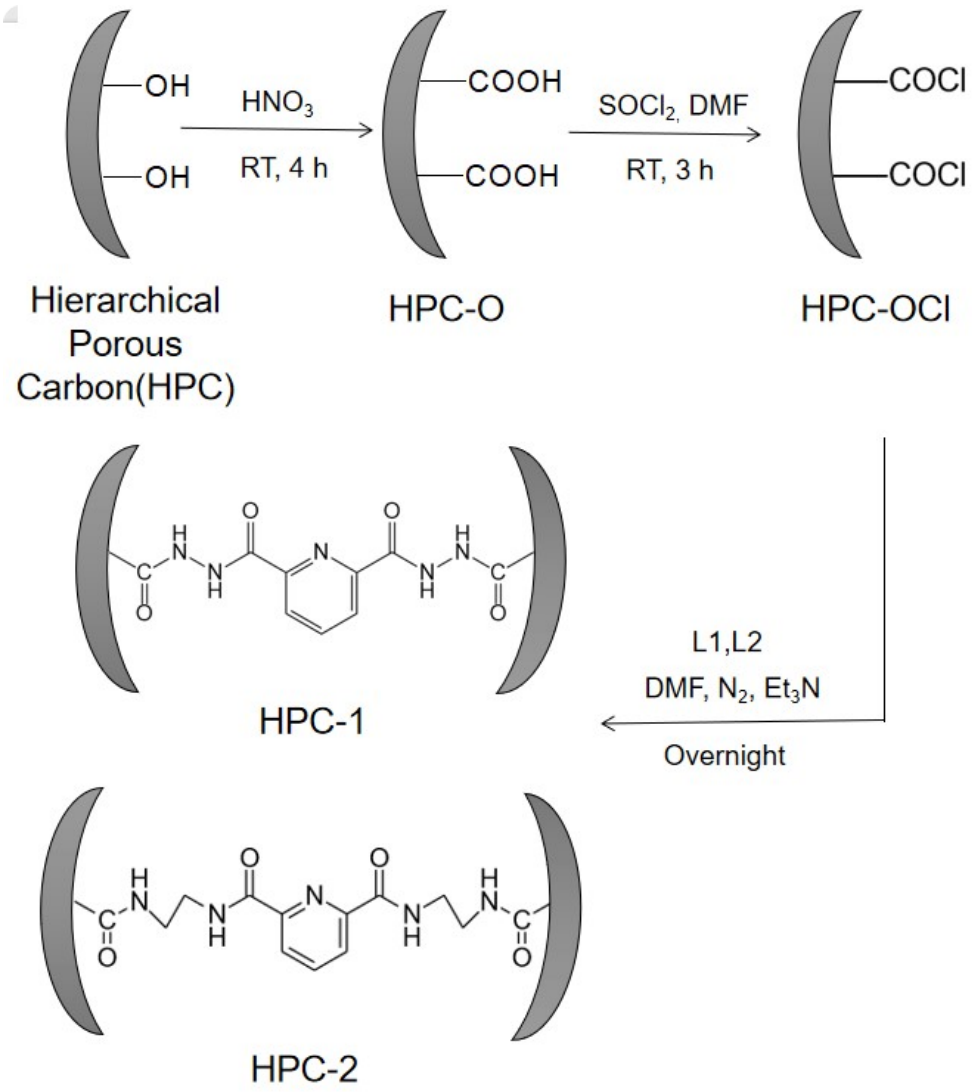


**Figure S2.** Schematic representation of the material surface modification process.

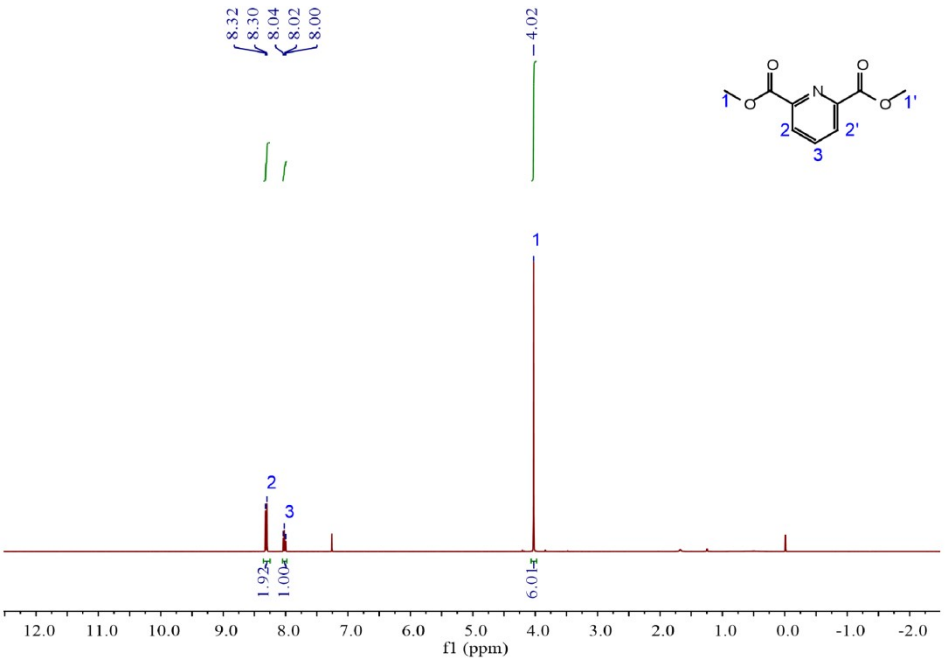


**Figure S3.** $^{1}H$ NMR of 2,6-Pyridinedicarboxate Dimethyl Ester ($CDCl_3$, 400 MHz).

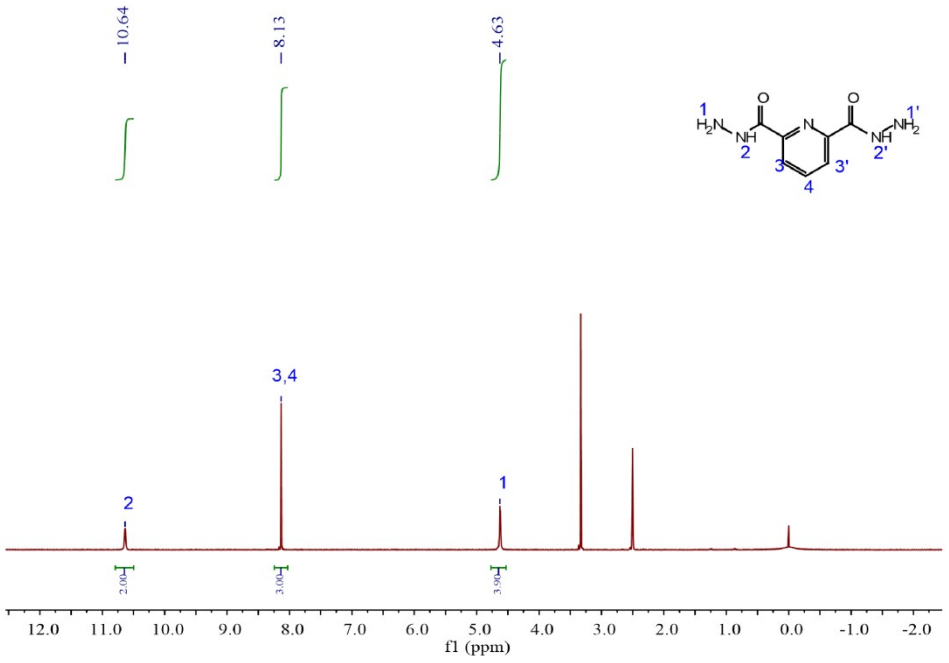


**Figure S4.** $^{1}$H NMR of pyridine-2,6-dicarboxylic acid diamide (DMSO-$d_6$, 400 MHz).

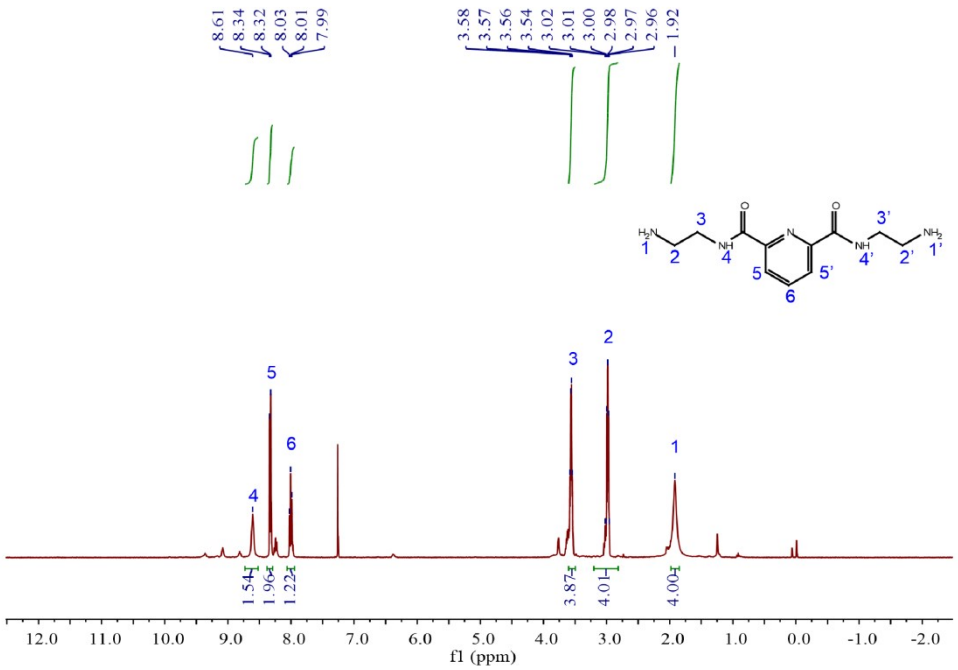


**Figure S5.** $^{1}$H NMR of N,N'-Bis(2-aminoethyl)-2,6-pyridinedicar-boxamide ($CDCl_3$, 400 MHz).

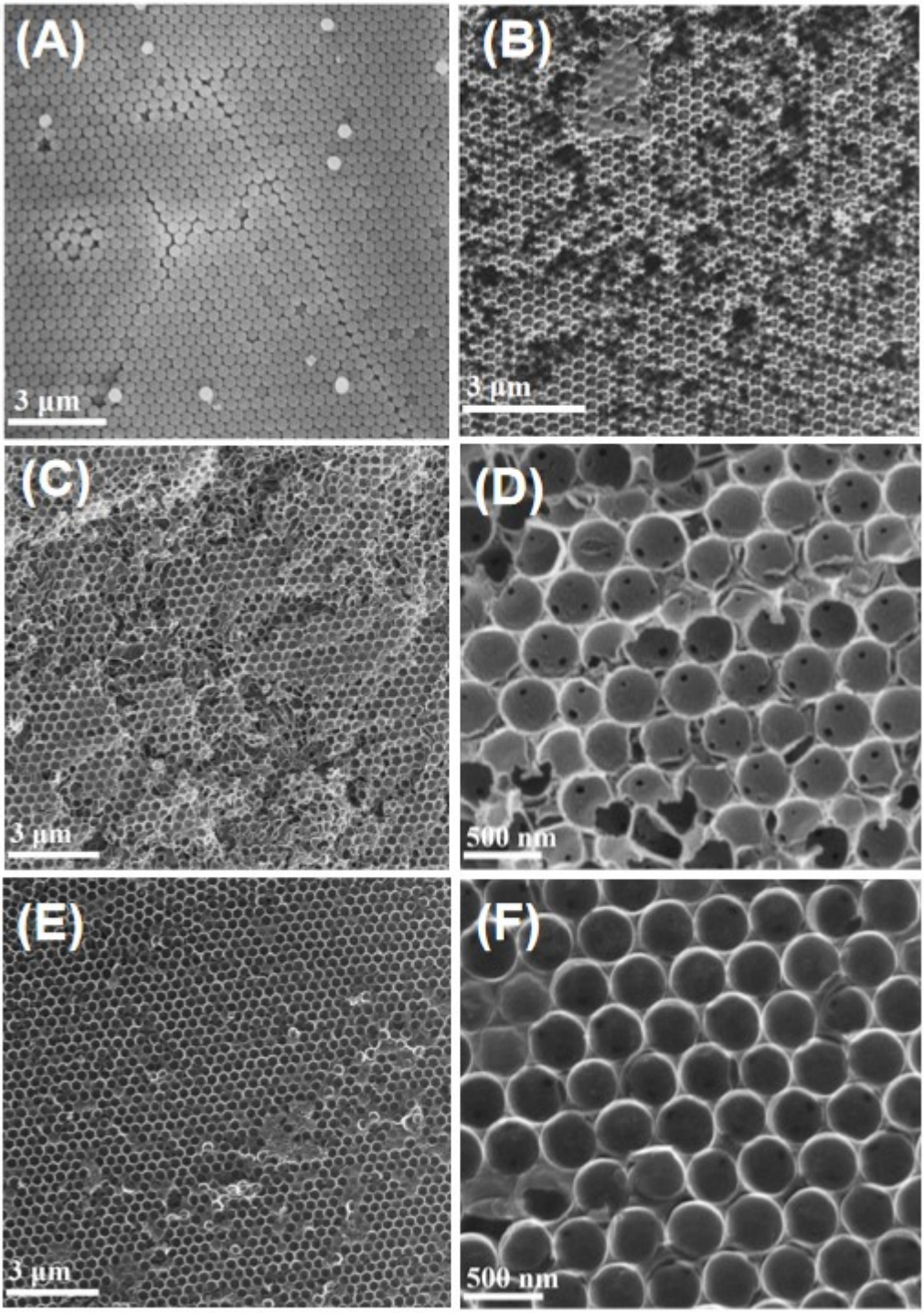


**Figure S6.** SEM images of $SiO_2$ (A), and HPC (B), MaC (C, D),and Ma-MeC (E, F).

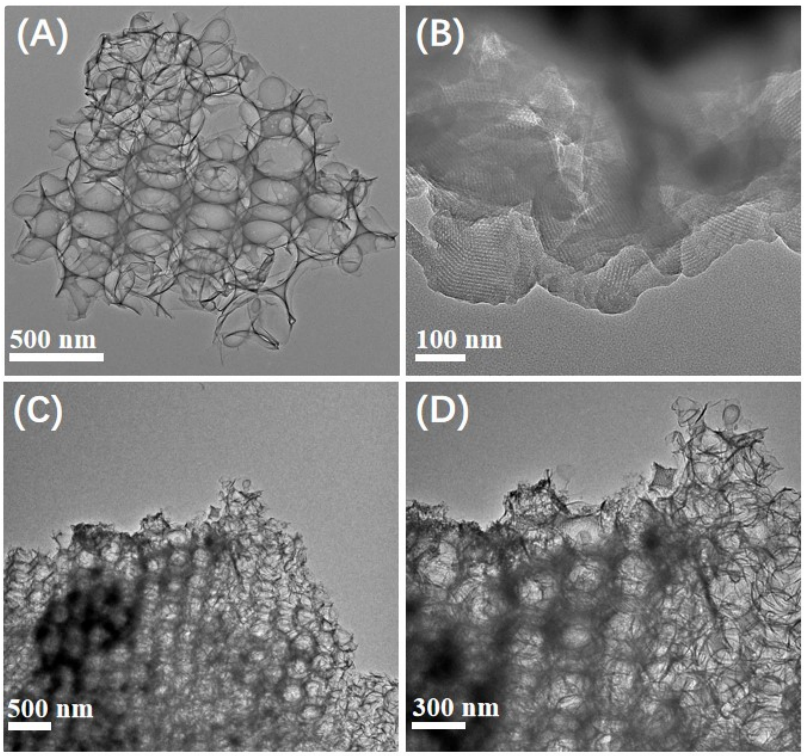


**Figure S7.** TEM images of MaC (A), MeC (B), and Ma-MeC (C, D).

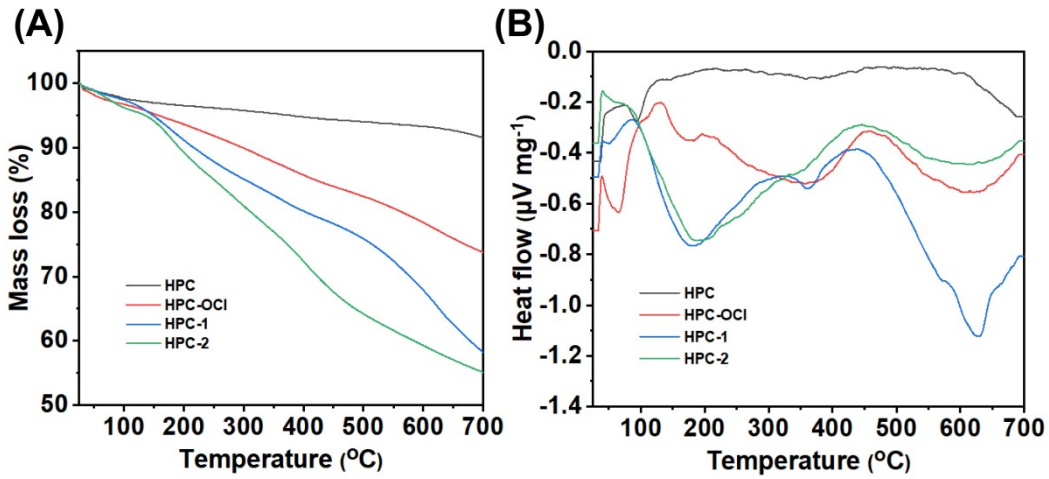


**Figure S8.** (A) TGA images of four materials (HPC、HPC-OCl、HPC-1、HPC-2) (B) DTA images of four materials (HPC, HPC-OCl, HPC-1, HPC-2).

**Table S1.** Peak values corresponding to each XPS image.

| | HPC | HPC-1 | HPC-2 | HPC-1-Sm |
|---|---|---|---|---|
| C 1s | 284.80 eV | 284.80 eV | 284.80 eV | 284.80 eV |
| | 286.18 eV | 286.13 eV | 286.00 eV | 286.22 eV |
| | 289.40 eV | 287.90 eV | 287.75 eV | 288.05 eV |
| O 1s | 531.12 eV | 531.45 eV | 531.29 eV | 530.83 eV |
| | 532.75 eV | 533.02 eV | 532.98 eV | 532.82 eV |
| | 534.83 eV | 535.21 eV | 535.26 eV | 535.15 eV |
| N 1s | -- | 398.85 eV | 398.89 eV | 399.70 eV |
| | -- | 400.49 eV | 400.48 eV | 401.51 eV |
| | -- | 404.93 eV | 404.71 eV | 404.91 eV |

**Table S2.** Langmuir and Freundlich isothermal model fitting results.

| | | Langmuir | | | Freundlich | | |
|---|---|---|---|---|---|---|---|
| Materials | $Q_{m,exp}$ (mg $g^{-1}$) | $R^2$ | $k_L$ (L $mg^{-1}$) | $Q_{m,cal}$ (mg $g^{-1}$) | $R^2$ | $k_F$ (mg $g^{-1}$) | 1/n |
| HPC | 11.30 | 0.99 | 10.31 | 11.91 | 0.85 | 7.42 | 0.28 |
| HPC-O | 49.85 | 0.98 | 19.36 | 57.13 | 0.88 | 8.63 | 0.36 |
| HPC-1 | 27.91 | 0.99 | 8.88 | 29.11 | 0.88 | 2.91 | 0.28 |
| HPC-2 | 23.56 | 0.99 | 8.83 | 24.41 | 0.85 | 6.44 | 0.27 |
| MaC-1 | 7.30 | 0.98 | 2.32 | 7.37 | 0.82 | 3.06 | 0.22 |
| Ma-MeC-1 | 22.12 | 0.99 | 8.26 | 22.35 | 0.86 | 5.96 | 0.27 |
| MeC-1 | 15.11 | 0.99 | 5.30 | 15.86 | 0.81 | 5.35 | 0.23 |

**Table S3.** Results of kinetic fitting.

| Materials | | Pseudo-first order kinetics modle | | | Pseudo-second order kinetics modle | | | |
|---|---|---|---|---|---|---|---|---|
| | $Q_{exp}$ (mg $g^{-1}$) | $Q_{cal}$ (mg $g^{-1}$) | $k_1$ ($min^{-1}$) | $R^2$ | $Q_{cal}$ (mg $g^{-1}$) | $k_2$ (g $mg^{-1}$ $min^{-1}$) | $t_{1/2}$ (min) | $R^2$ |
| HPC | 8.97 | 8.53 | 0.52 | 0.90 | 8.94 | 0.092 | 1.21 | 0.99 |
| HPC-O | 42.03 | 41.06 | 0.53 | 0.96 | 42.98 | 0.019 | 1.22 | 0.98 |
| HPC-1 | 23.02 | 21.74 | 0.22 | 0.97 | 22.64 | 0.016 | 2.76 | 0.99 |
| HPC-2 | 22.29 | 19.56 | 0.36 | 0.91 | 20.38 | 0.032 | 1.53 | 0.96 |
| MaC-1 | 7.10 | 7.00 | 1.44 | 0.96 | 7.12 | 0.42 | 0.33 | 0.99 |
| Ma-MeC-1 | 19.52 | 21.74 | 0.93 | 0.88 | 22.64 | 0.074 | 0.60 | 0.99 |
| MeC-1 | 13.50 | 13.09 | 0.10 | 0.97 | 14.24 | 0.010 | 7.02 | 0.99 |

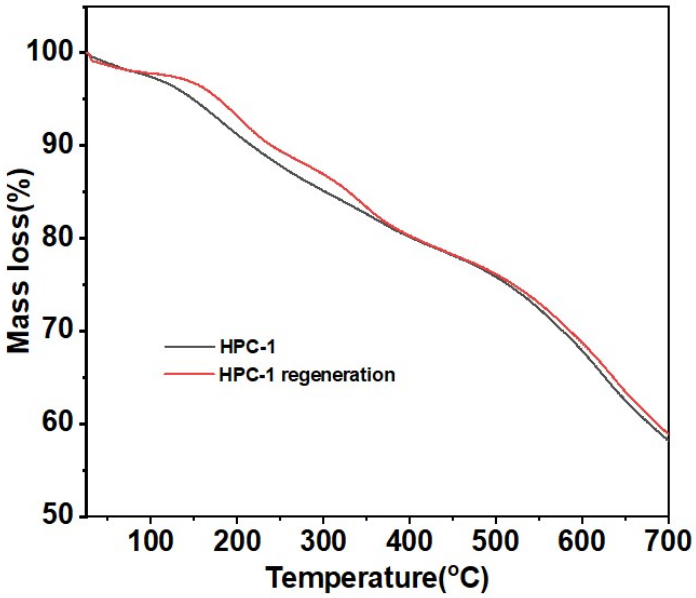


**Figure S9.** TGA images of the initial and recycled adsorbent.