# 3D nano crystalline metal-organic framework materials improve output performance of triboelectric nanogenerator

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## Supporting Information

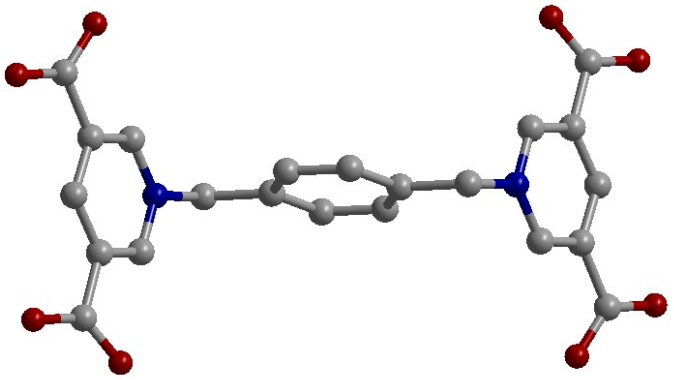

**Fig. S1** Chemical structure of twisted organic ligand.

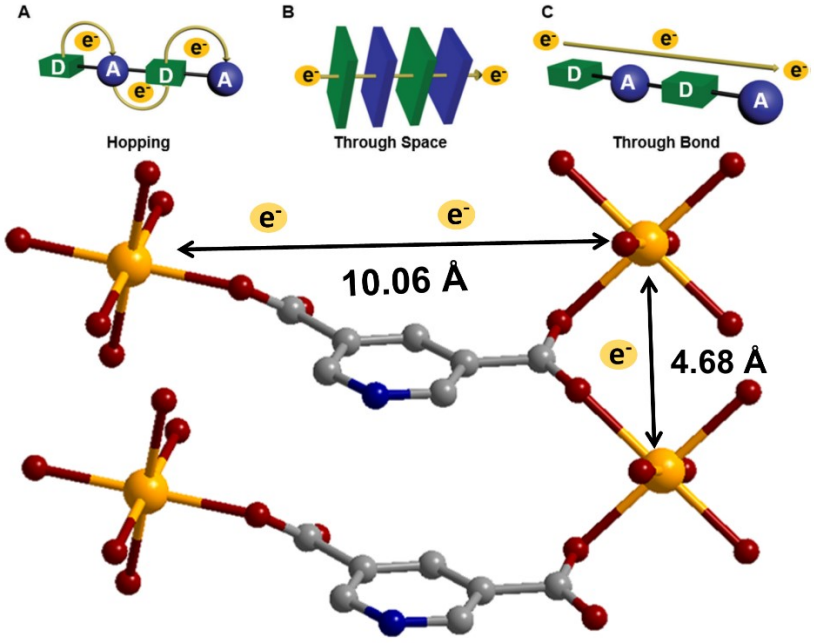


**Fig. S2** The possible modes of charge transfer in Cd-MOF.

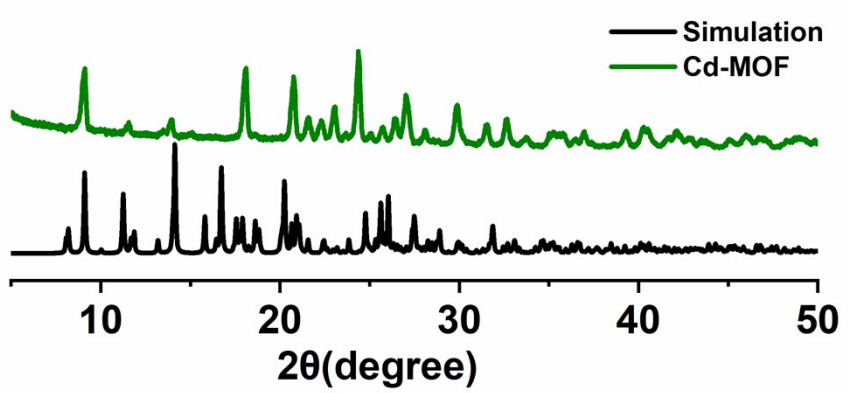


**Fig. S3** PXRD pattern of Cd-MOF.

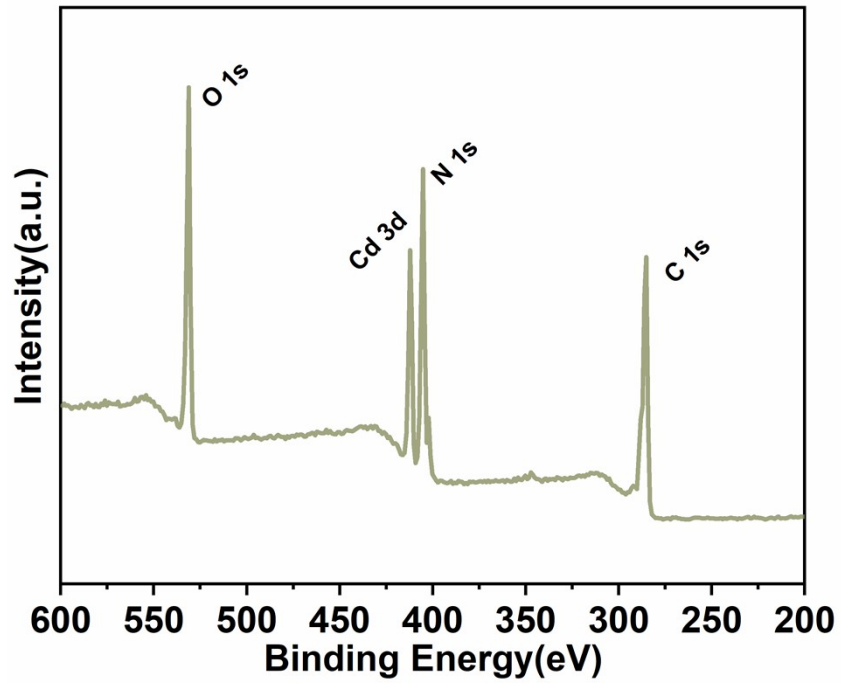


**Fig. S4** XPS full spectra of Cd-MOF.

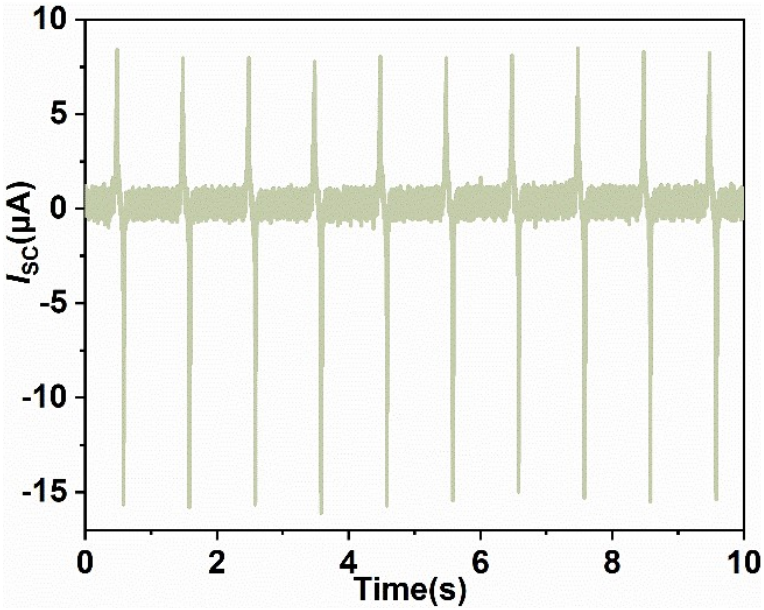


**Fig. S5** $I_{SC}$ of Cd-MT at 1 Hz.

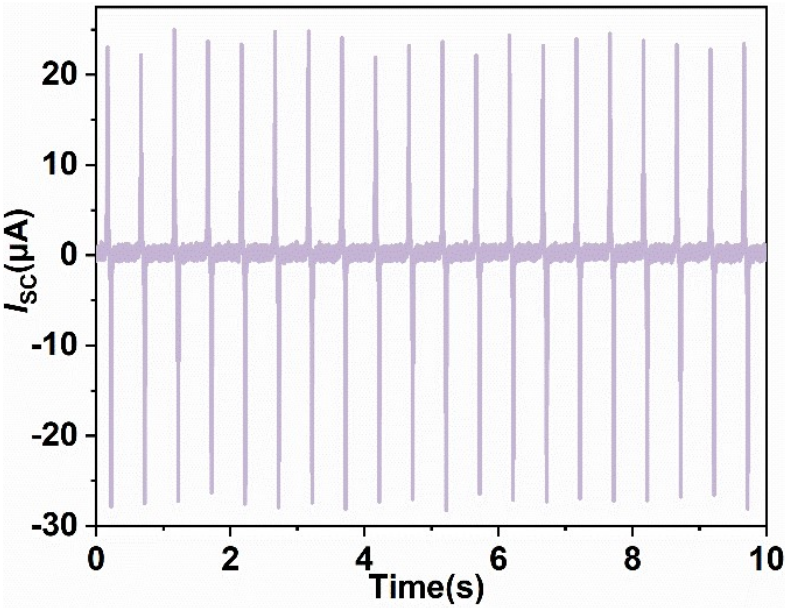


**Fig. S6** $I_{SC}$ of Cd-MT at 2 Hz.

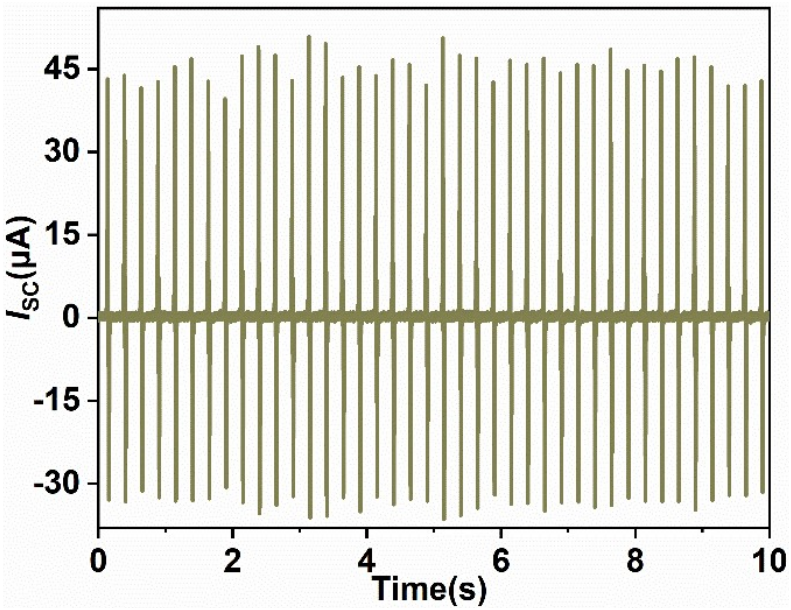


**Fig. S7** $I_{SC}$ of Cd-MT at 4 Hz.

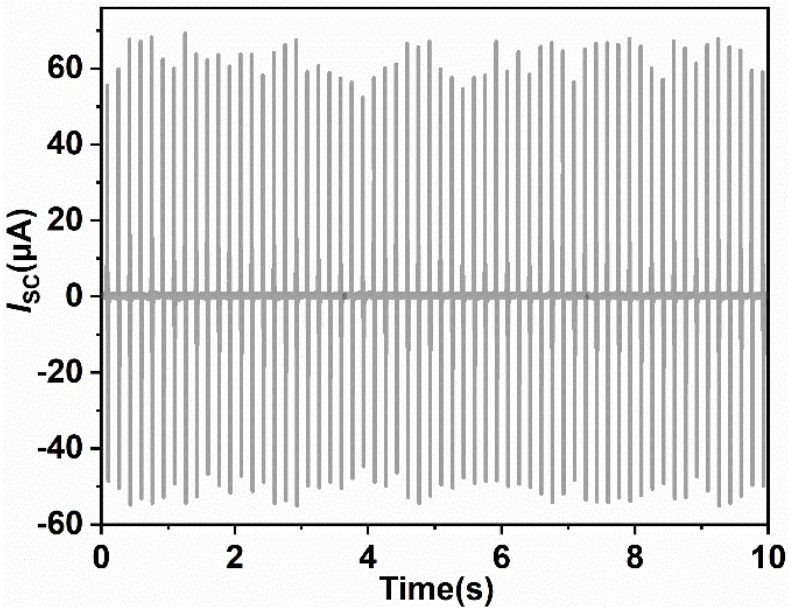


**Fig. S8** $I_{SC}$ of Cd-MT at 6 Hz.

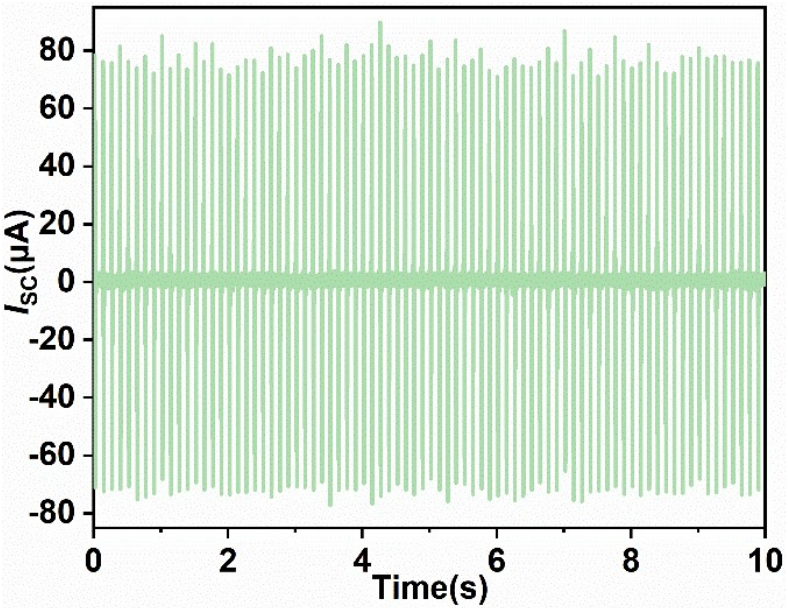


**Fig. S9** $I_{SC}$ of Cd-MT at 8 Hz.

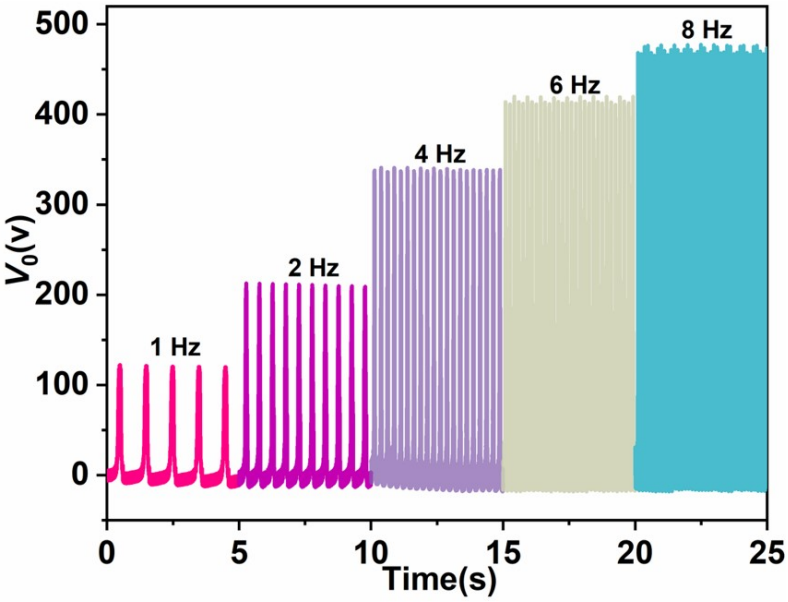


**Fig. S10** $V_0$ of Cd-MT at different frequency.

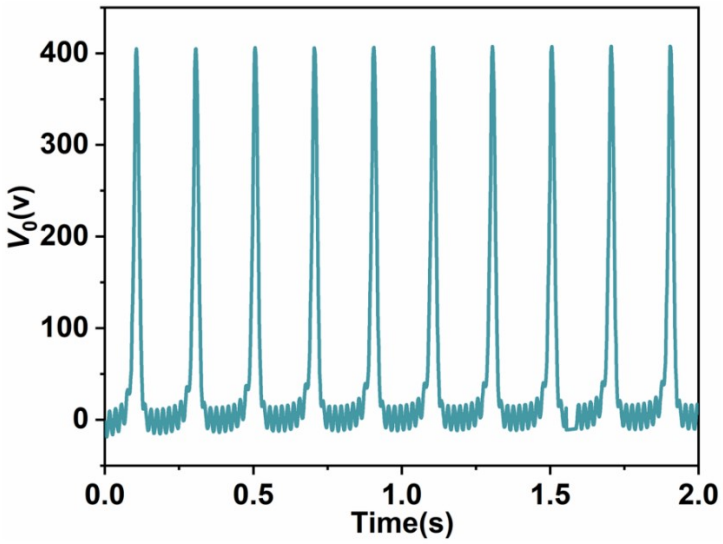


**Fig. S11** $V_0$ of Cd-MT at 5 Hz.

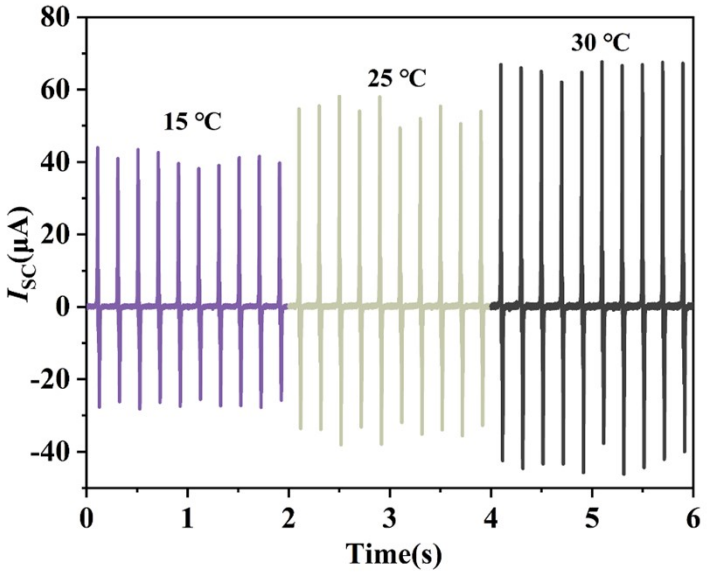


**Fig. S12** Effect of temperature on output performance in Cd-MT.

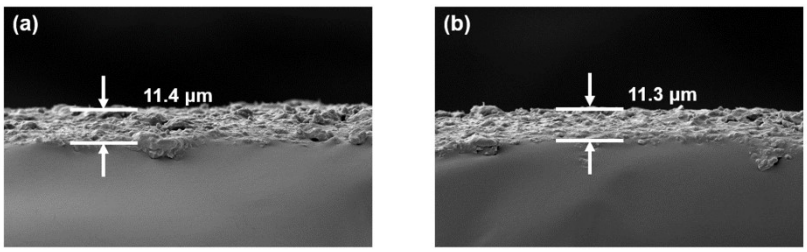


**Fig. S13** SEM images of Cd-MOF on the Cu layer (a) before and (b) after testing.

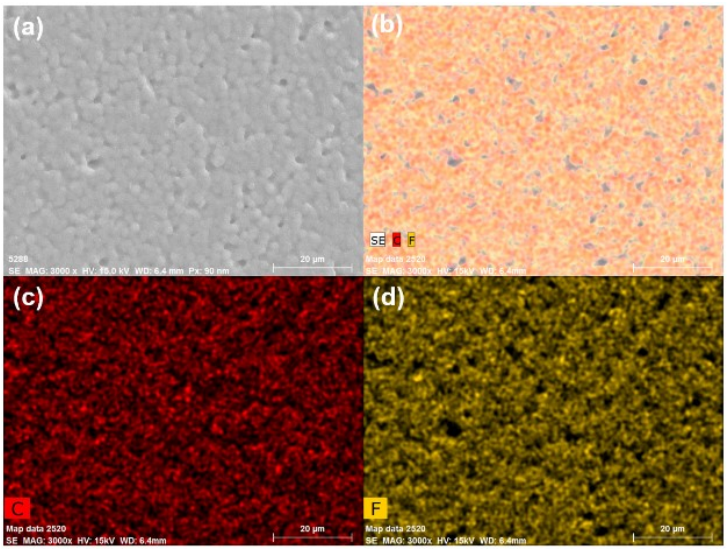


**Fig. S14** EDS elemental analysis of PVDF layer.

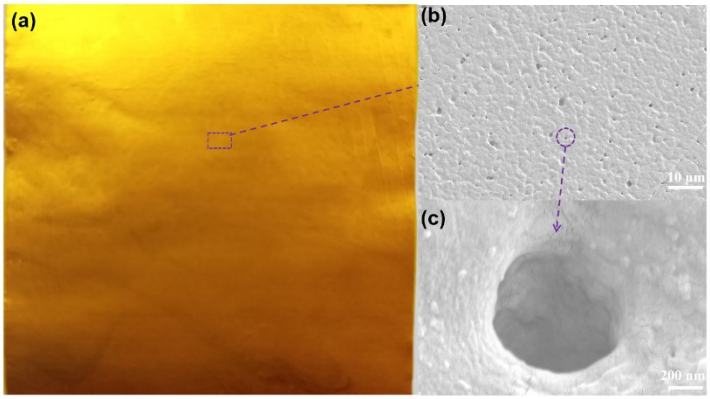


**Fig. S15** High-definition digital and SEM images of PVDF layer.

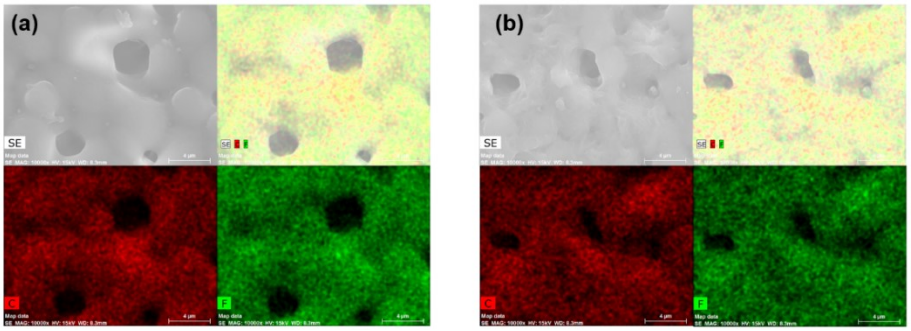


**Fig. S16** EDS images of PVDF layer (a) before and (b) after testing.

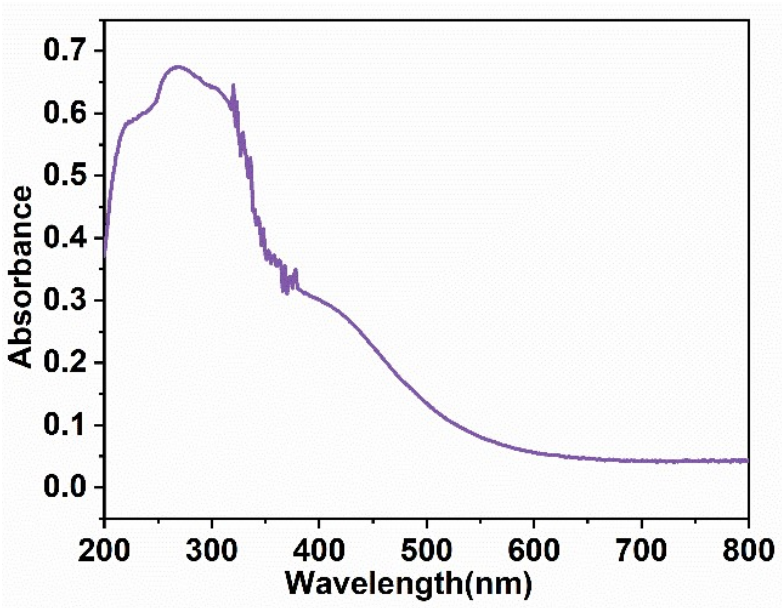


**Fig. S17** Uv-vis spectra of Cd-MOF.

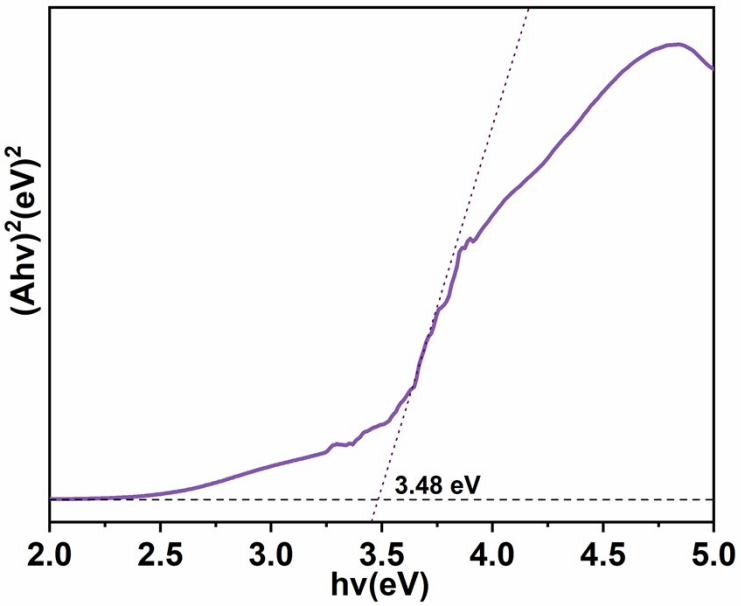


**Fig. S18** Tauc plot of Cd-MOF.

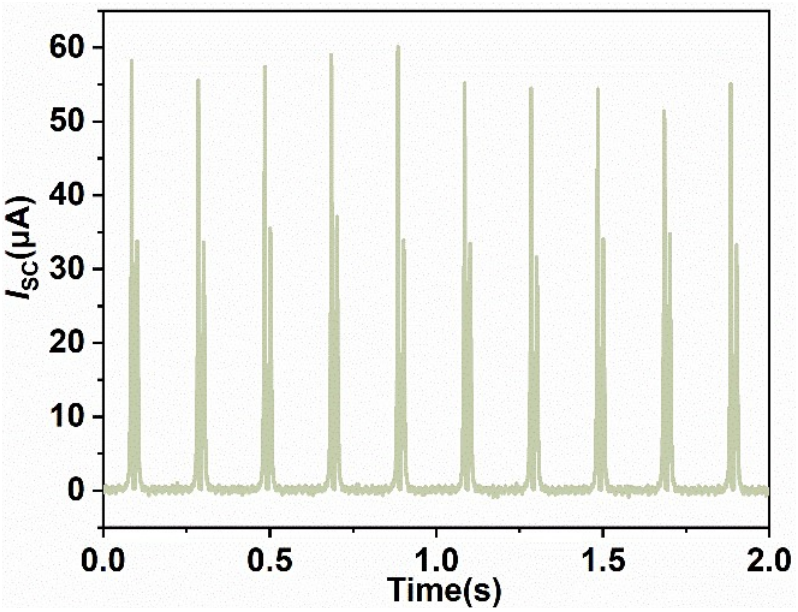


**Fig. S19** $I_{SC}$ of Cd-MT through a rectifier bridge.

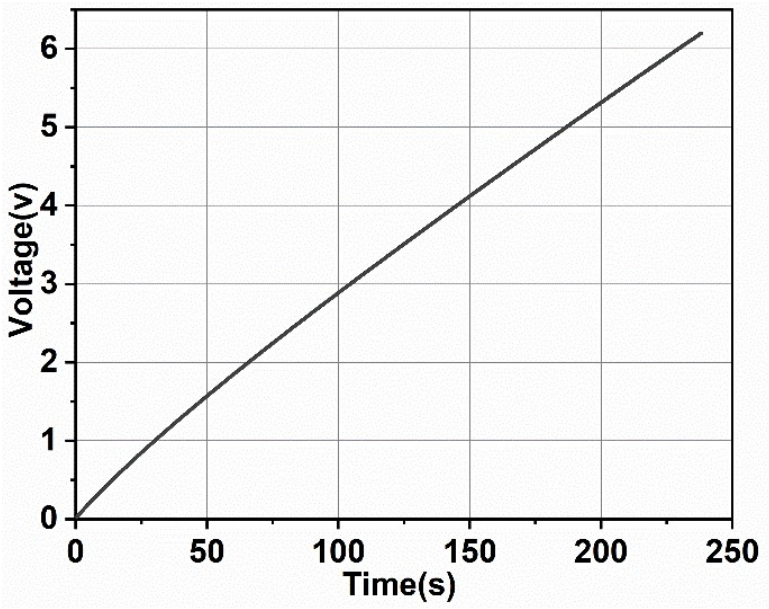


**Fig. S20** The charging of 100 μF capacitor using Cd-MT at 5Hz.

**Table S1** Crystallographic data and structure refinement details for Cd-MOF.

| Compound | Cd-MOF |
|---|---|
| Formula | $C_{22}H_{14}N_2O_8Cd$ |
| Mr | 546.76 |
| T/K | 273 K |
| l (Mo–Ka)/Å | 0.71073 |
| Crystal system | Triclinic |
| Space group | $P2_1/c$ |
| a/Å | 4.6802(7) |
| b/Å | 15.507(2) |
| c/Å | 12.8345(17) |
| α (deg) | 90 |
| β (deg) | 93.757(5) |
| γ (deg) | 90 |
| V (Å$^3$) | 929.5(2) |
| Z | 2 |
| Dcalcd (g cm$^{-3}$) | 1.954 |
| F(000) | 544.0 |
| μ (mm$^{-1}$) | 1.235 |
| $R_1$ (I > 2σ(I)) | 0.0398 |
| $wR_2$ (I > 2σ(I)) | 0.1091 |
| $R= [\sum \| \| F_0 \| - \| F_c \| \| / \sum \| F_0 \| ]$, $R_W = \sum_W [\| F_0^2 - Fc^2 \|^2 / \sum_W (\| F_w \|^2)^2]^{1/2}$ | |

**Table S2** Selected bond lengths (Å) and bond angles (deg) for Cd-MOF crystal structure description.

| Cd-MOF | | | |
|---|---|---|---|
| Cd1—O2 | 2.233 (3) | Cd1—O3ii | 2.327 (3) |
| Cd1—O4i | 2.279 (3) | O2iii—Cd1—O4i | 92.62 (11) |
| O4i —Cd1—O3ii | 94.81 (11) | O2—Cd1—O4i | 87.38 (11) |
| O4iv—Cd1—O3ii | 85.19 (11) | O2iii—Cd1—O4iv | 87.38 (11) |
| O2iii—Cd1—O3v | 86.01 (11) | O2—Cd1—O4iv | 92.62 (11) |
| O2—Cd1—O3v | 93.99 (11) | O2iii—Cd1—O3ii | 93.99 (11) |
| O4i —Cd1—O3v | 85.19 (11) | O2—Cd1—O3ii | 86.01 (11) |
| O4iv—Cd1—O3v | 94.81 (11) | | |
| Symmetry codes: | #1 x+1, -y+1/2, z-1/2; #2 -x+2, y+1/2, -z+1/2; #3 -x+2, -y+1, -z; #4 -x+1, y+1/2, -z+1/2; #5 x, -y+1/2, z-1/2 | | |