Room Temperature Ammonia Gas Sensor Based on Cerium oxide/Mxene and Self-powered by Freestanding-mode Triboelectric Nanogenerator and its Multifunctional Monitoring Application

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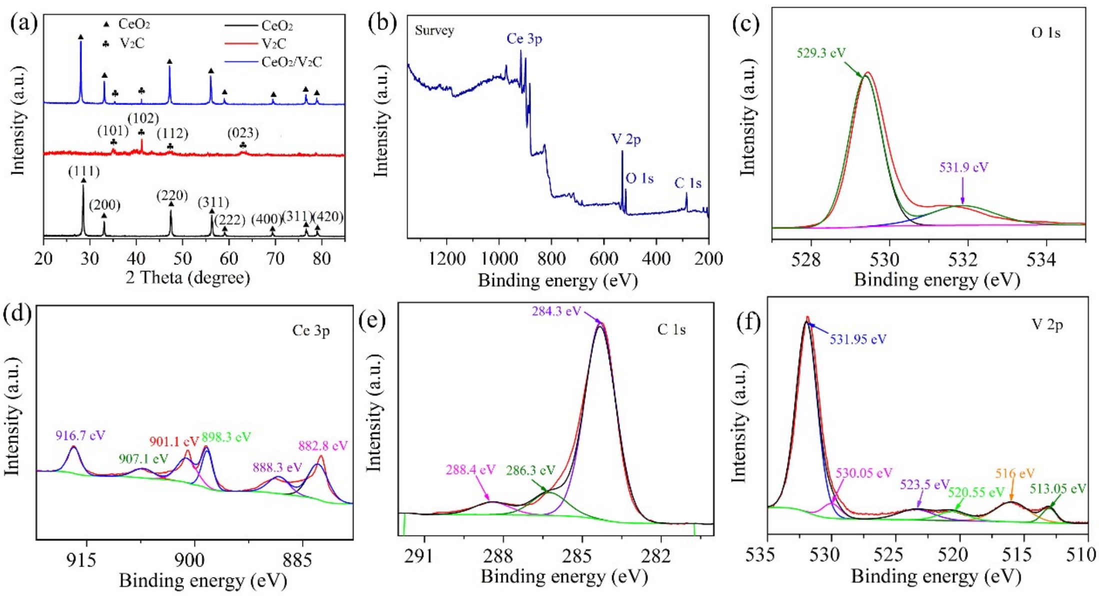

Figure S1. (a) XRD pattern of V_2C, CeO_2 and CeO_2/V_2C samples. XPS spectra of CeO_2/V_2C nanohybrid: (b) Survey spectrum, (c) O 1s spectrum, (d) Ce 3p spectrum, (e) C 1s spectrum, (f) V 2p spectrum.

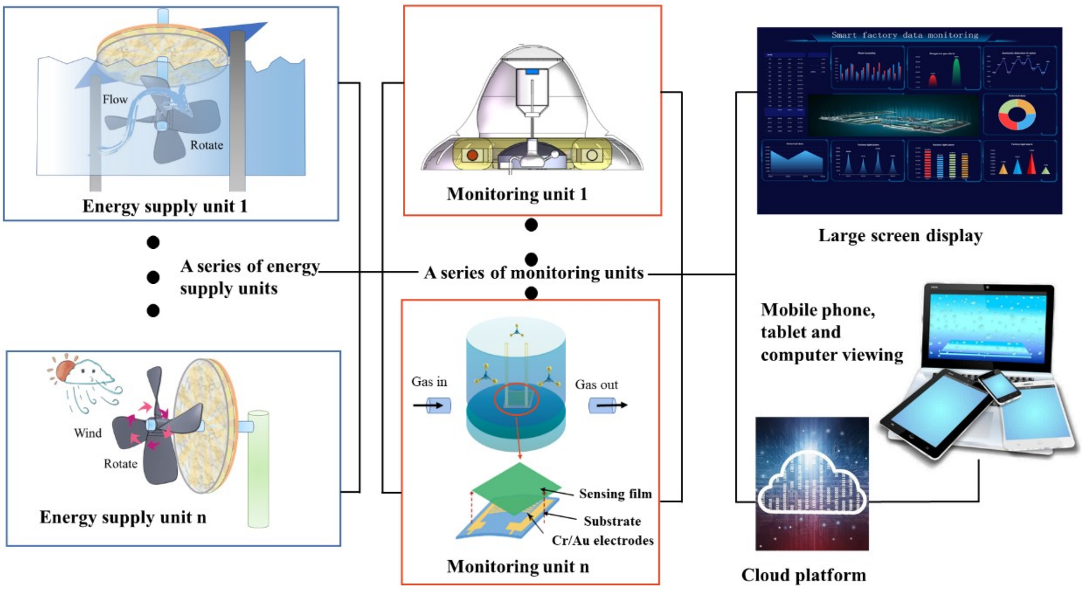

Figure S2. Gas sensor performance test platform.

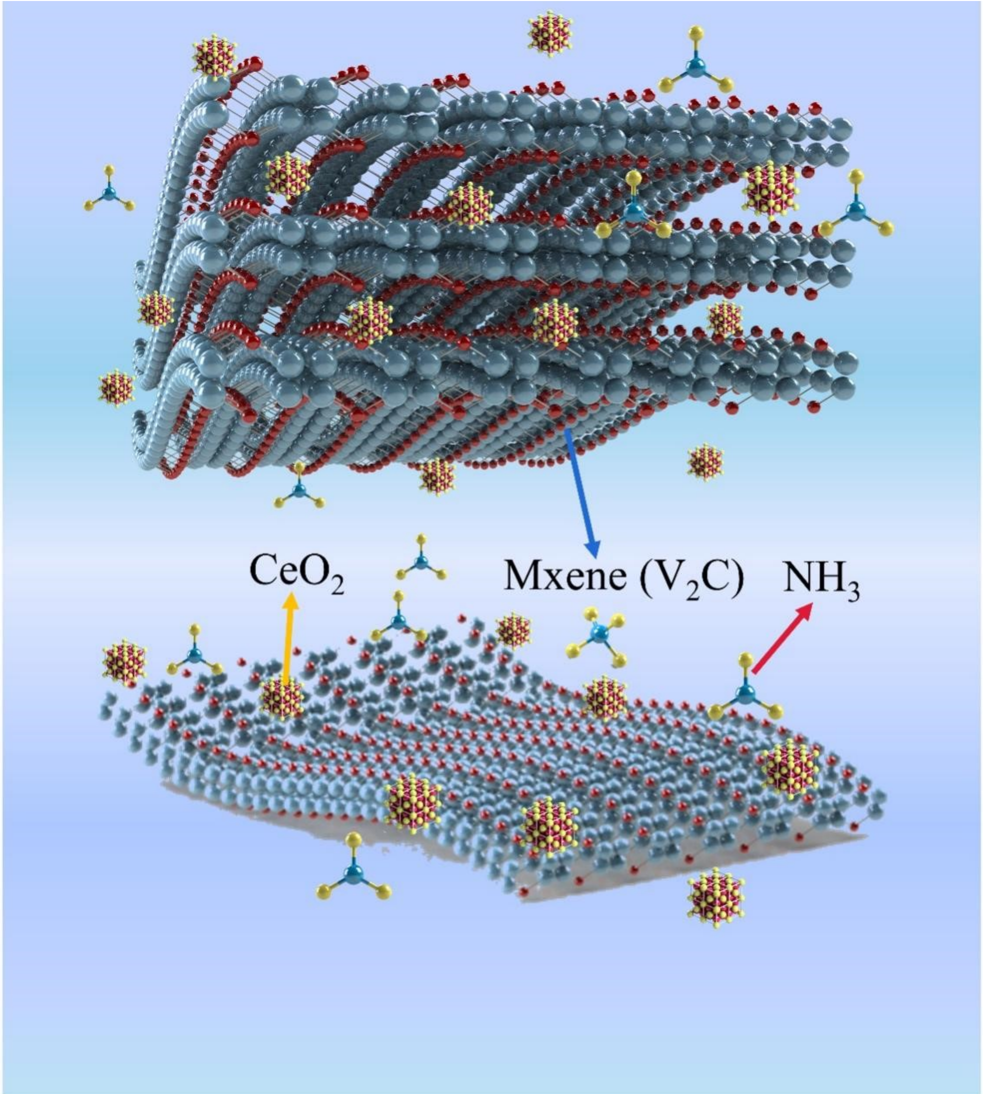

Figure S3. Schematic diagram of ammonia sensing mechanism of CeO_2/MXene composite.

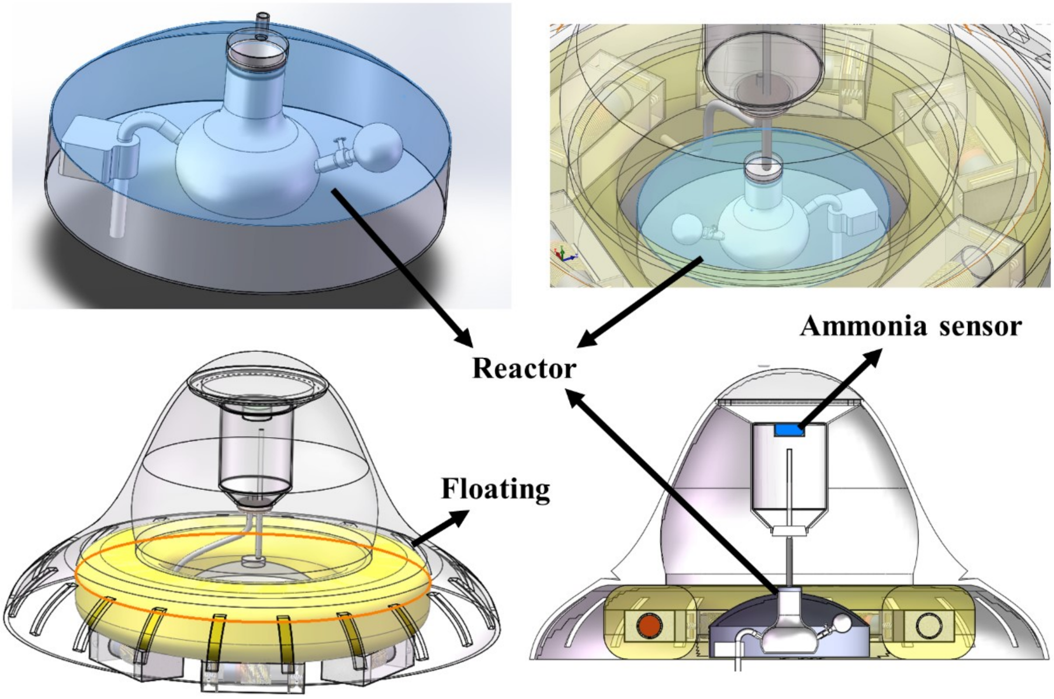

Fig. S4. Modeling diagram of water ammonia monitoring device.

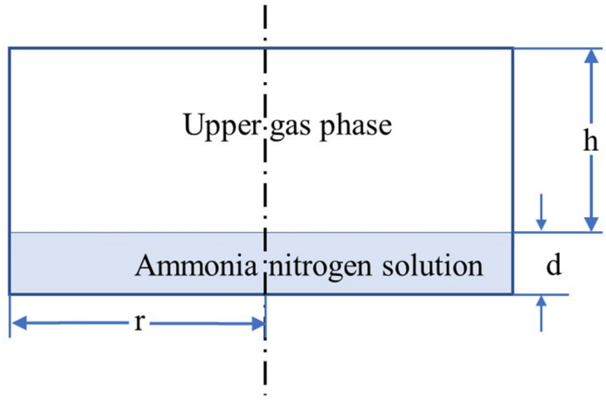

Fig. S5. Schematic diagram of gas-liquid distribution model for ammonia nitrogen concentration detection in water.

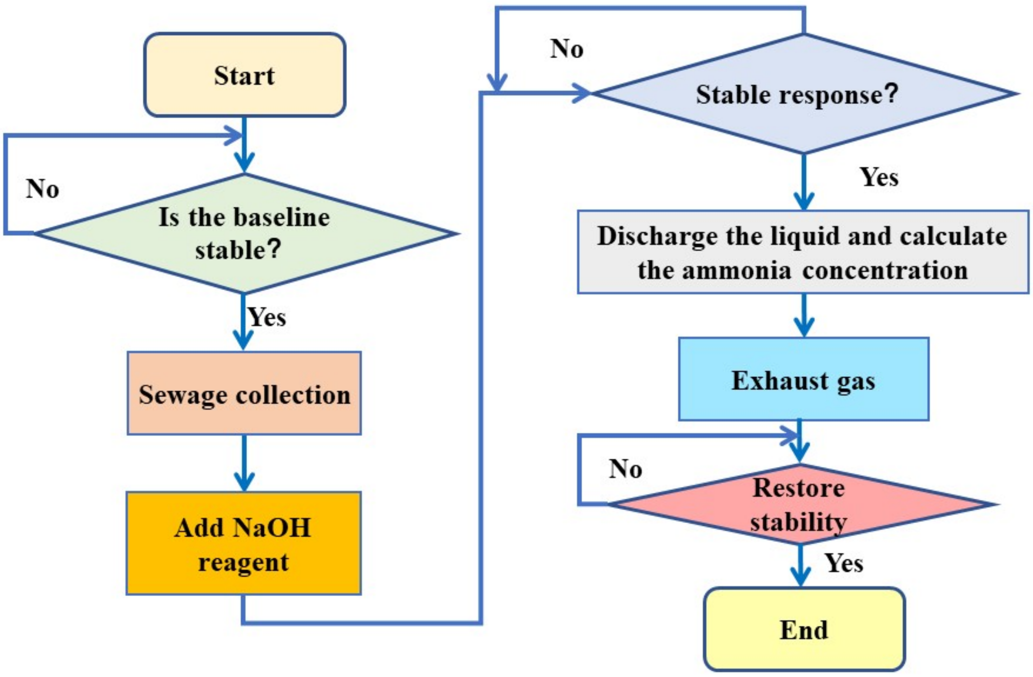

Fig. S6. Flow chart of single water ammonia nitrogen concentration detection process.

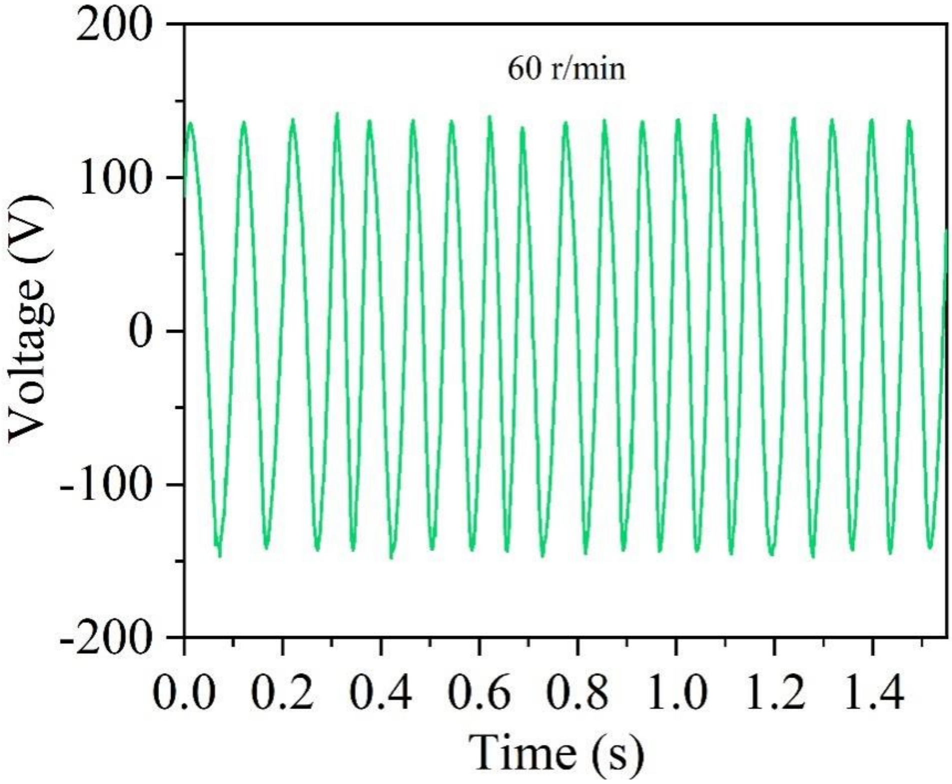

Fig. S7. Curve of open circuit voltage versus time at 60 r/min.

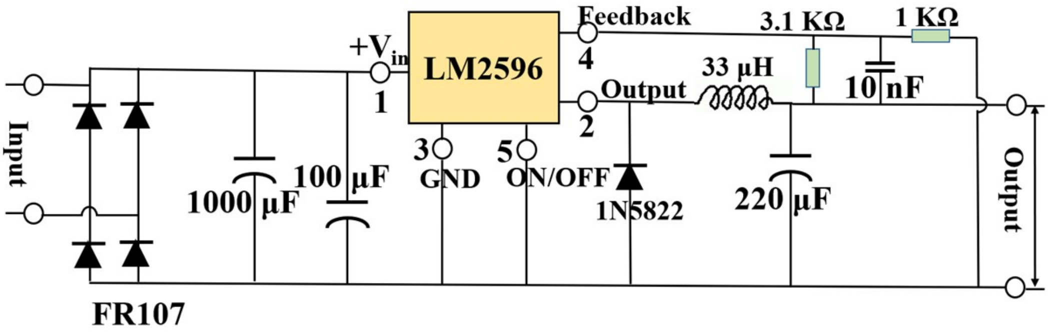

Fig. S8. Schematic diagram of voltage stabilizing circuit.

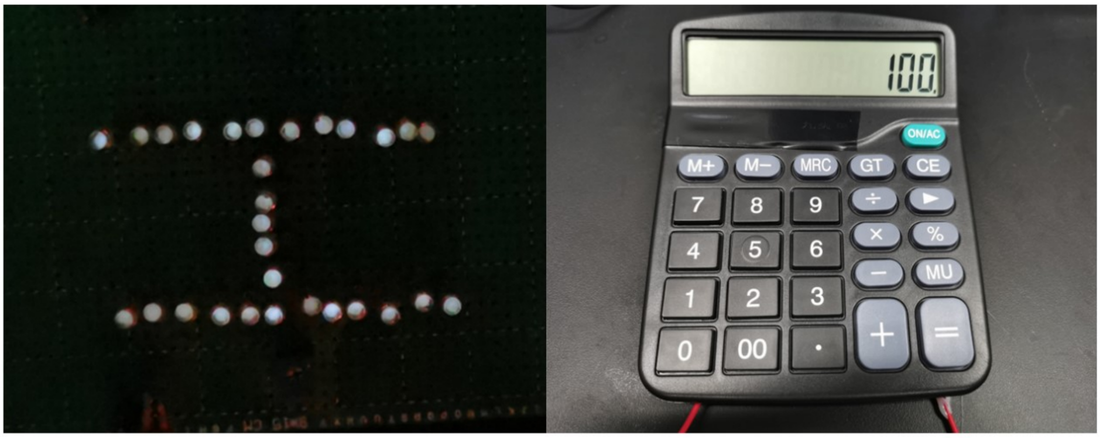

Fig. S9. TENG lights up the LED and the calculator.

Table S1 Response value, response time and recovery time of the presented NH_3 sensors in this work.

Sensing material	Sensor response (%)	Response time T_{res} (s)	Recovery time T_{rec} (s)
	50 ppb	50 ppb	50 ppb
CeO_2	23.1	14	22
CeO_2/MXene	36.8	12	19

Table S2 Performance comparison of the presented sensor in this work with the previous reported NH_3 sensors.

Sensing material	Detection limit (ppm)	Conc. (ppm)	(Response (%))	T_{res} (s)	T_{rec} (s)	Ref.
MXene/CuO	1	100	24.8	43	26	[1]
SnS_2/Ni	10	180	14.7	40.6	33.7	[2]
CNTs/PPy	0.2	5	20	90	450	[3]
$Ti_3C_2T_x$/TiO_2/MoS_2	0.5	100	163.3	117	88	[4]
MWCNTs/PANI	33	50	117	47	-	[5]
$Ti_3C_2T_x$/SnO_2	0.5	50	40	36	44	[6]
S-rGO/WS_2	10	10	250	60	300	[7]
BP/TiO_2	5	5	19.7	412	690	[8]
MCNT/PPy	0.05	50	26	11.7	91.8	[9]
Sb-WO_3	0.2	5	122	-	320	[10]
$Ti_3C_2T_x$/SnO	1	10	67	61	119	[11]
CeO_2/V_2C	0.025	0.05	782.4	12	19	This work

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