Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

Flat flexible thin milli-electrode array for real-time *in situ* water quality monitoring in distribution systems

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Figure S1. Fabrication process of five types of MEA sensors on a Kapton film, including (a) Kapton substrate preparation, (b) printing the gold/ silver layer on the substrate, (c) wire bonding, (d) waterproof layer coating, (e) working electrode modification and (f) the final layout of pH, temperature, conductivity, Cl^- and ClO^- MEA sensors for real-time monitoring of water quality.

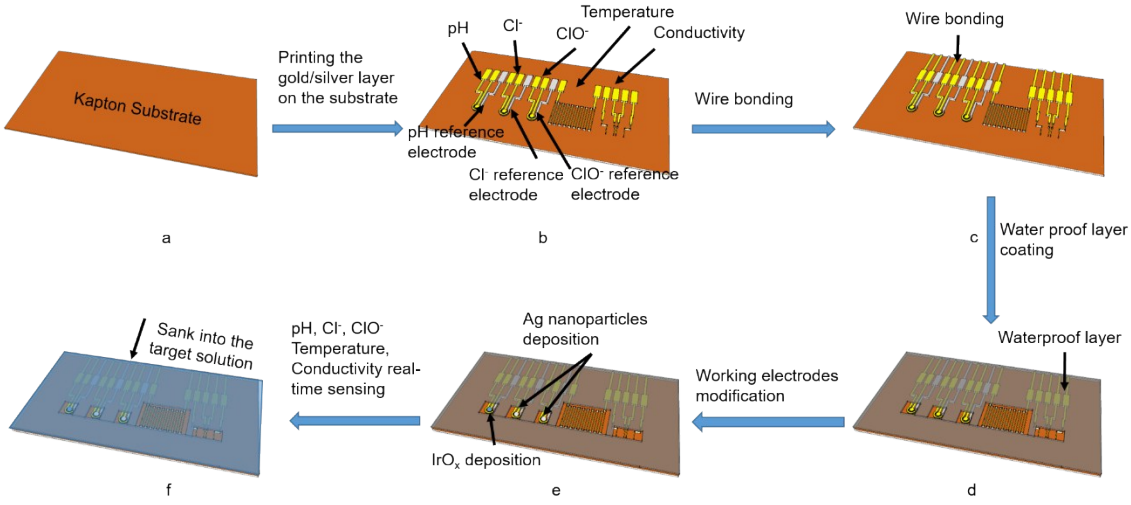


Figure S2. MEA calibration and shock experiment setup (Inserted picture: the demo of the MEA sensor film attached to a transparent PVC pipeline for lab tests).

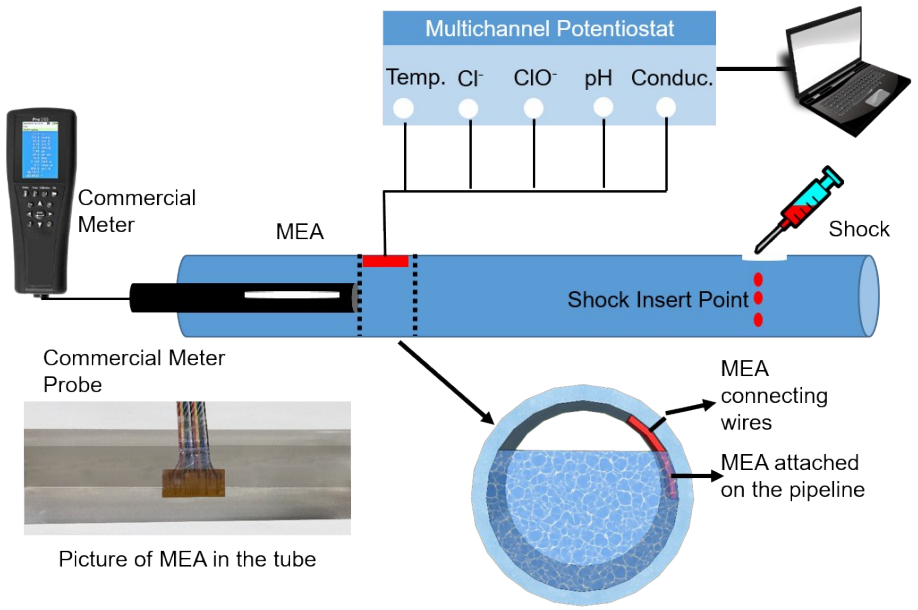
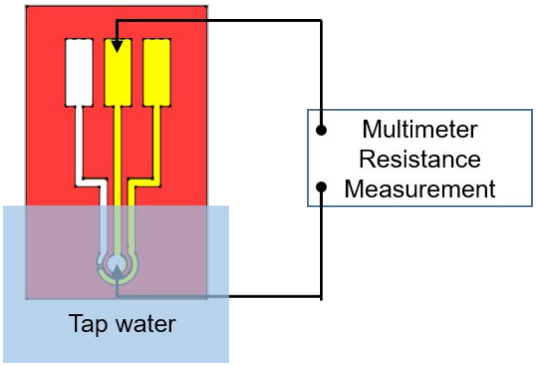
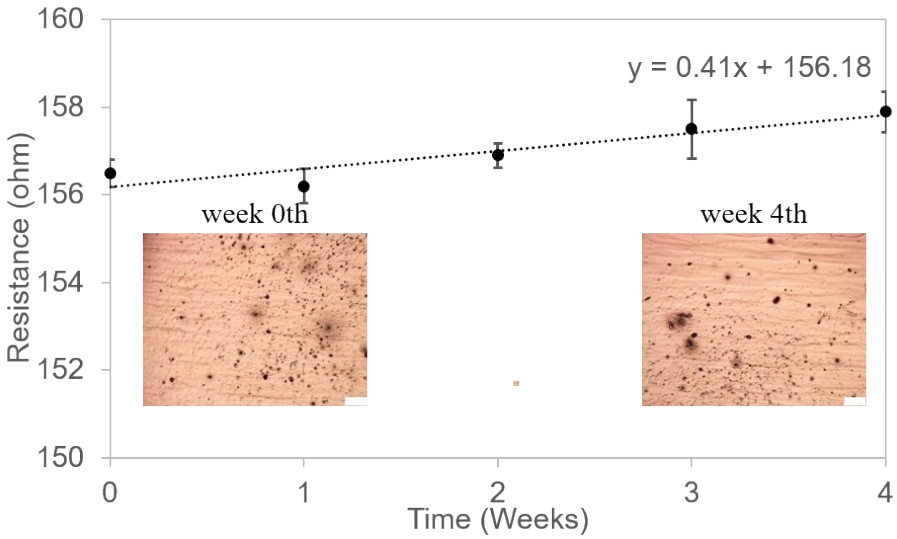


Figure S3. Long-term stability of Cl^- and ClO^- MEAs within 4-week operational period, including (a) experiment setup. The resistance of a MEA with the working electrode modified by Ag nanoparticles immersed into tap water was continuously read using a multiple meter during 4-week period, (b) the variation of the resistance of MEA sensors over 4-week period (Insert pictures: microscale images of the silver working electrodes before and after immersion into tap water for 4 weeks, scale bar 100μm) and (c) microscale images of the working electrodes before the CV program was conducted and after 500 circles of the CV program.

a.



b.


160
158
156
154
152
150
Resistance (ohm)
y = 0.41x + 156.18
week 0th
week 4th
0
1
2
3
4
Time (Weeks)

c.

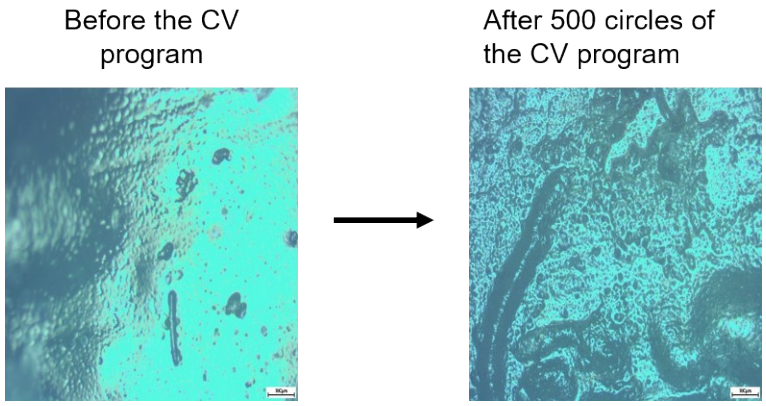
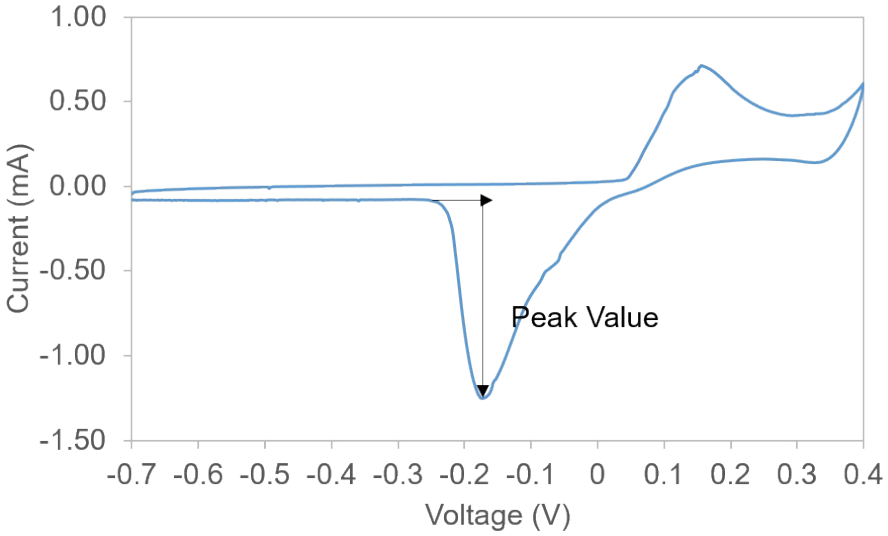

Before the CV program
After 500 circles of the CV program

Figure S4. Selectivity tests of MEA sensors using **c**yclic voltammetry (CV) curve. (a) the silver (Ag) working electrode of a chloride (Cl^-) MEA in 32mM chloride (Cl^-) solution, and (b) the silver (Ag) working electrode of a hypochlorite (ClO^-) MEA in 32mM hypochlorite (ClO^-) solution.

a.



b.

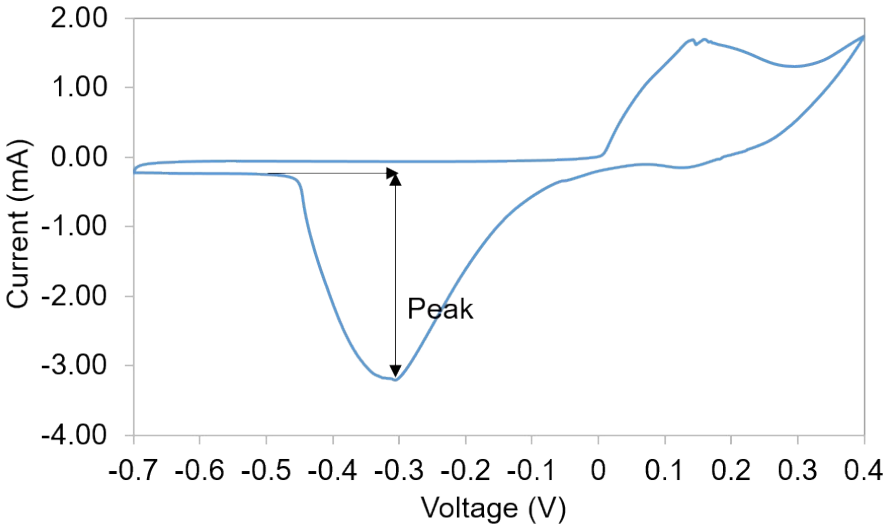
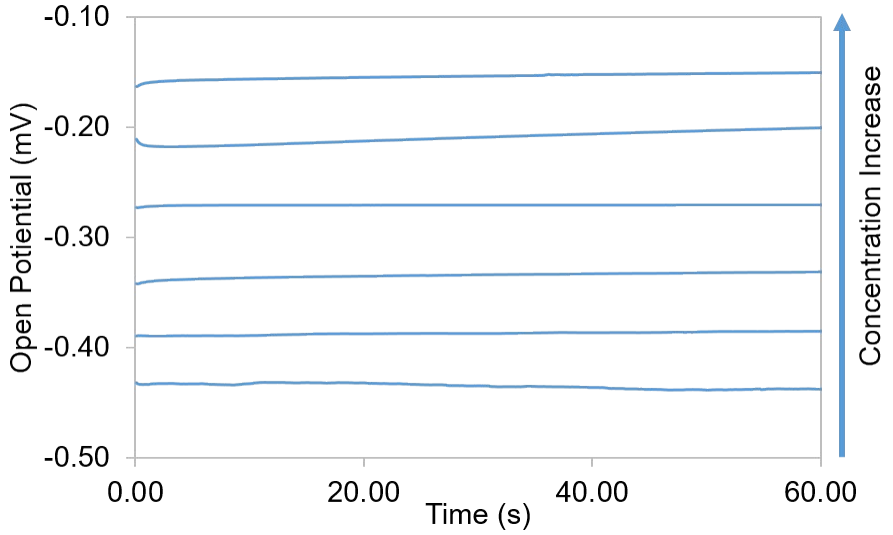


Figure S5. (a) Potential readings of the Cl^- MEA changes over time and (b) open potential responses (mV) of the Cl^- MEA at different Cl^- concentrations (The dashed line shows the trend).

a.



b.

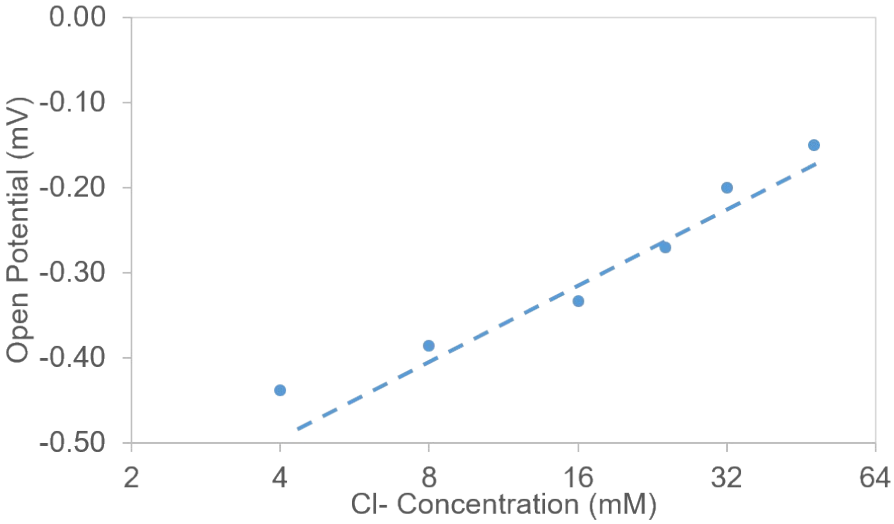
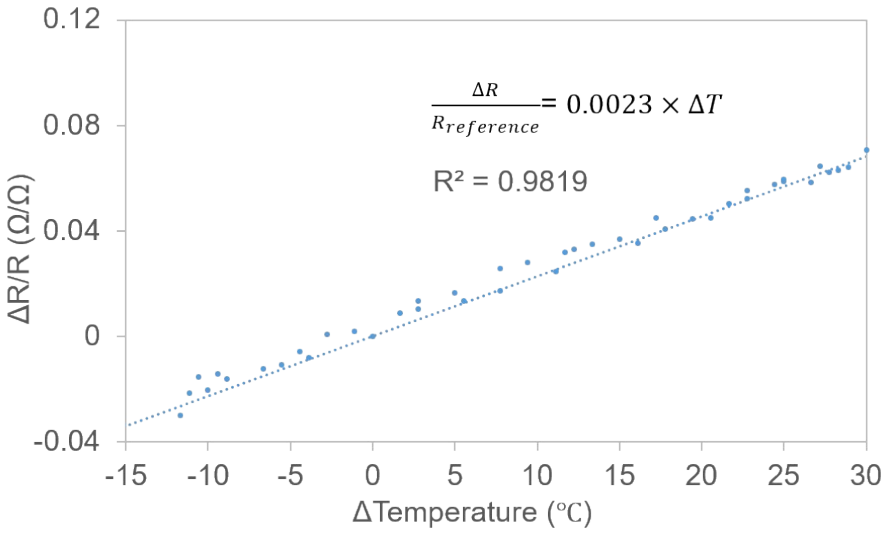
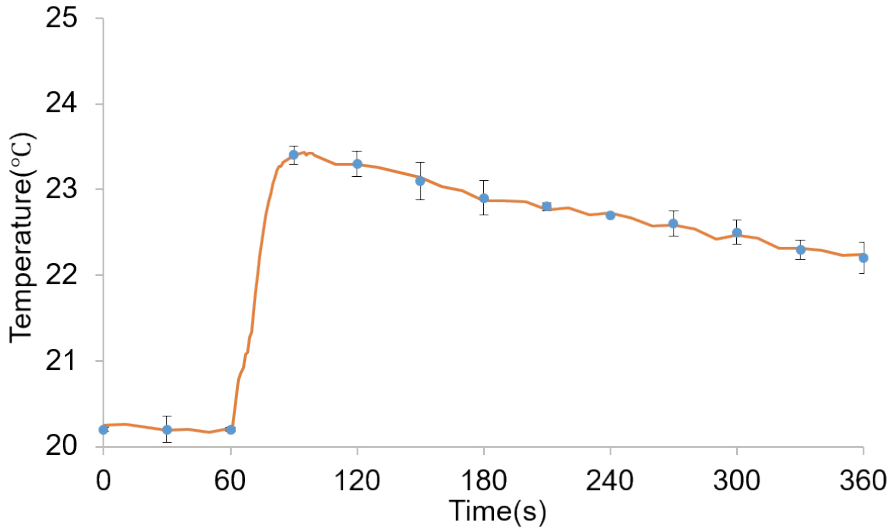


Figure S6. (a) The linear regression model of the temperature MEA resistance (Ω) v.s. temperature (ºC), (b) the response of temperature MEA to the temperature shock and (c) the linearity regression model of the conductivity MEA resistance (Ω) v.s. conductivity (μs/cm).

a.



b.



c.

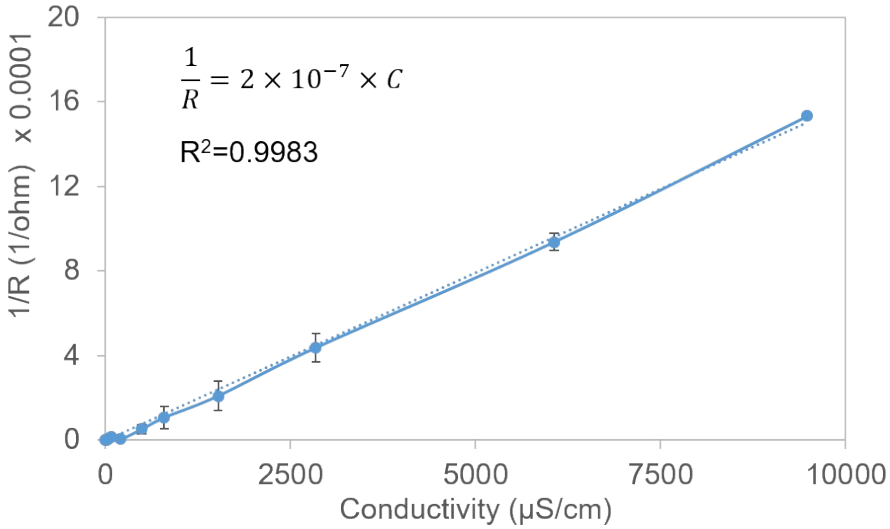
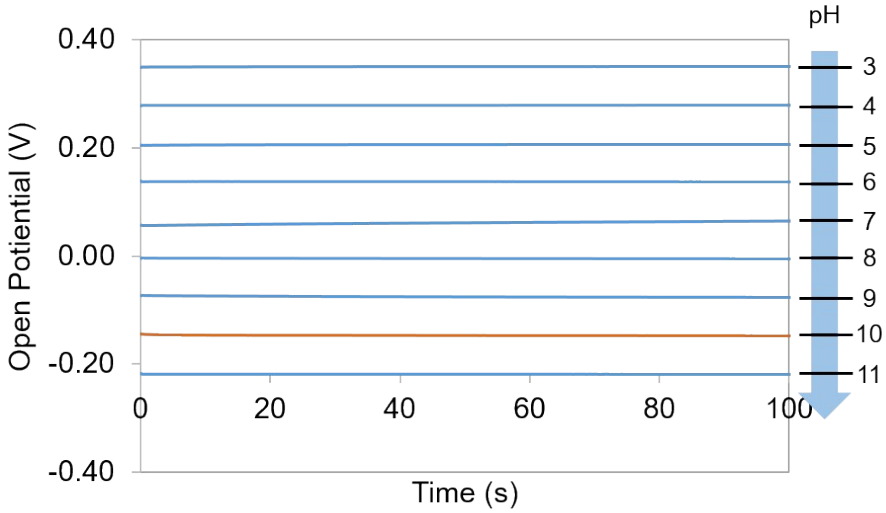

$\frac{1}{R} = 2 \times 10^{-7} \times C$
R²=0.9983
1/R (1/ohm) x 0.0001
20
16
12
8
4
0
0
2500
5000
7500
10000
Conductivity (µS/cm)

Figure S7. (a) Potential readings of the pH MEA in the pH=3-11 solutions change over time and (b) the linear regression model of the pH MEA potential (V) vs pH.

a.



b.

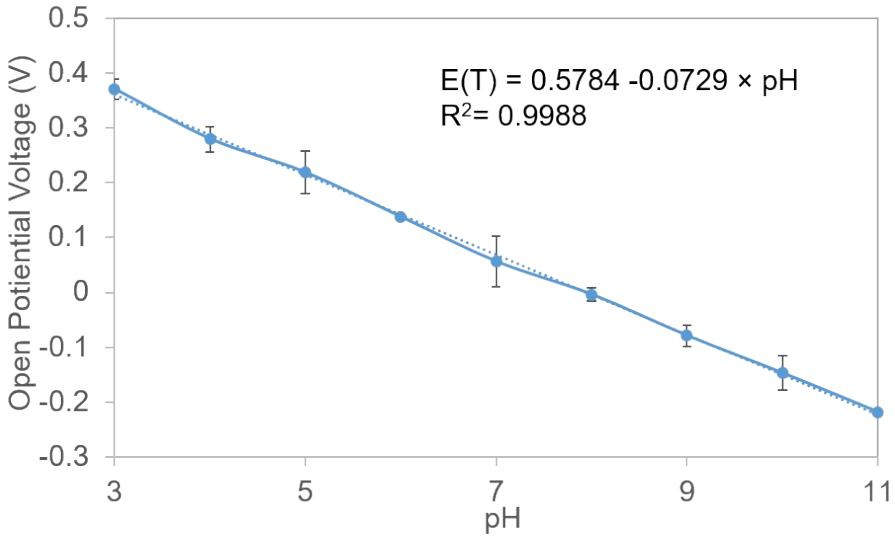


Figure S8. The response of MEA sensors to the shock of Cl^- dropping from 8 mM (Co) to 5.4 mM (C_{final}) (Inserted figure: CV curves of Cl^- before and after shocks).