Supplementary Information (SI) for Journal of Materials Chemistry A.

Supporting Information:

Output Power Density Enhancement of Intermittently Contacted Metal Semiconductor Junction with Water Interlayer

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Work function measurement of electrode surface:

The work function of electrodes is measured with the AFM tip coated Pt/Ir layer (PPP-EFM, Nano Sensor) through Bruker Dimension Icon AFM system in Kelvin Probe Force Microscopy (KPFM) model. The images of KPFM as shown in Figure 1b. The KPFM results (V_{Si}) of hydrophilic n-type Si, ordinary n-type Si and hydrophobic n-type Si electrode surfaces are about $-0.83\ V$, $-0.47\ V$ and $-0.05\ V$, respectively. The KPFM result (V_{Au}) of Au electrode is about $-0.16\ V$. According to the principle of KPFM, we can calculate the surface work function W_{Si} of n-type Si electrodes as: $W_{Si} = W_{Au} - e(V_{Si} - V_{Au})$, where $W_{Au} = 5.1\ eV$ is the work function of Au electrode surface.

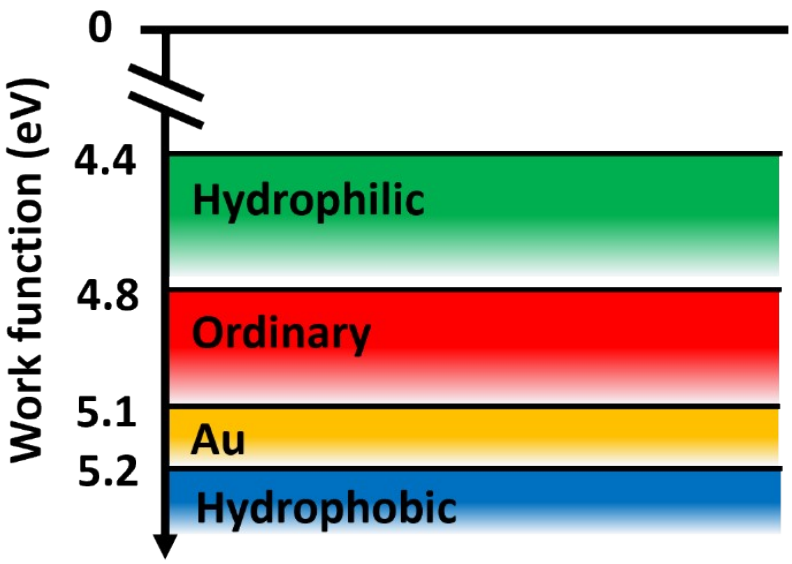
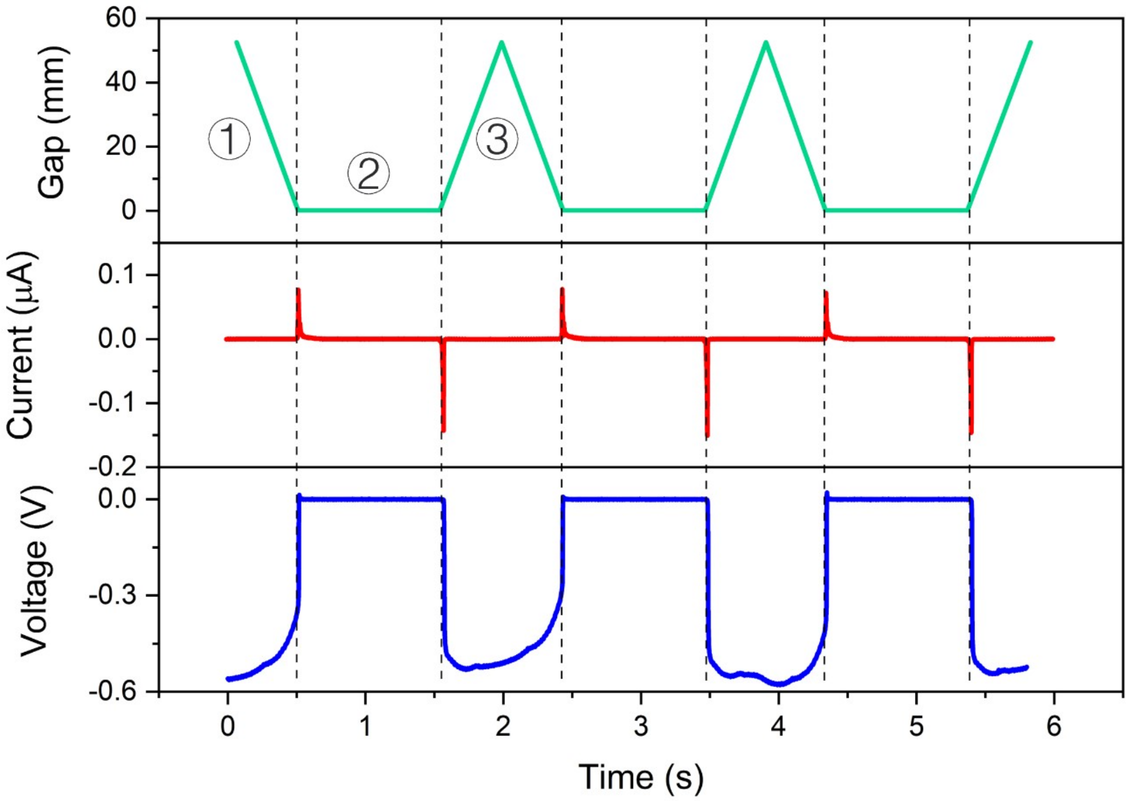


Figure S1. Work function of the Au and Si surfaces.



Figures S2. Short-circuit current and open-circuit voltage of the intermittently contacted ordinary Au-Si junction in response to the gap width.

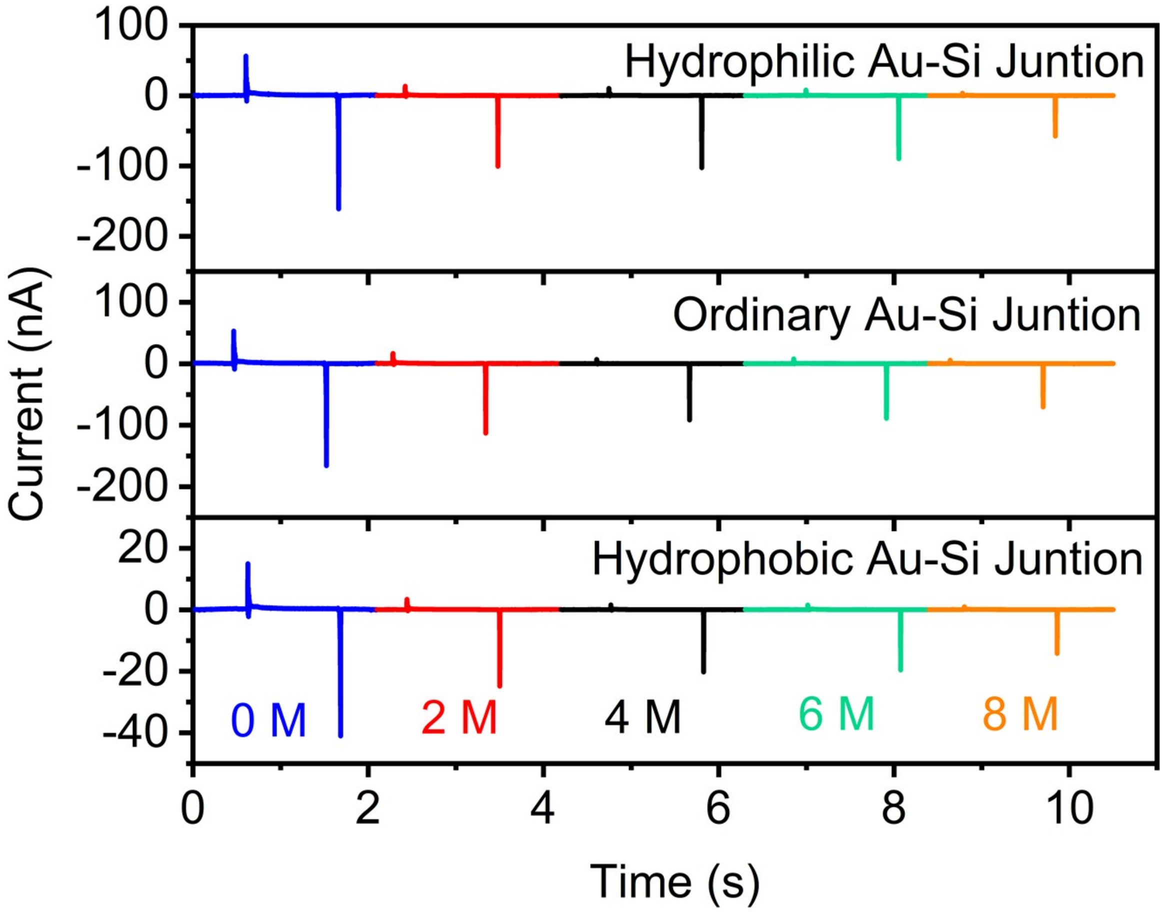


Figure S3. Output currents with different external loads of the intermittently contacted Au-Si junctions.

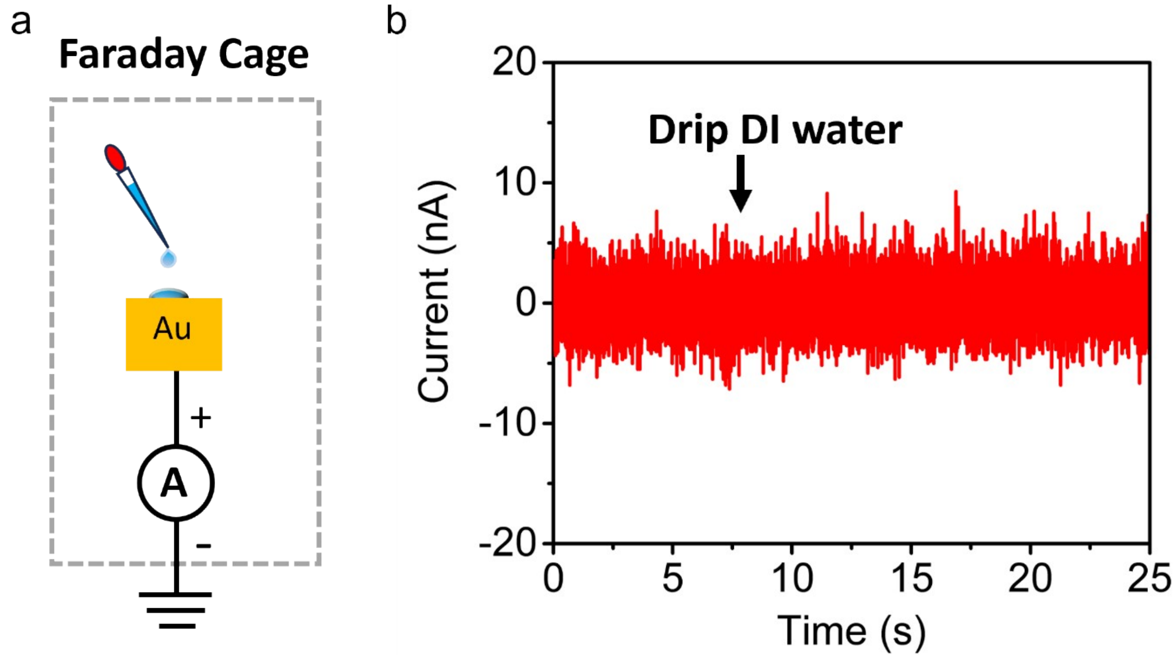


Figure S4. Set-up to test the charge in the water. (a) The schematic of the test. (b) The electric signal before and after the water is introduced onto the Au surface.

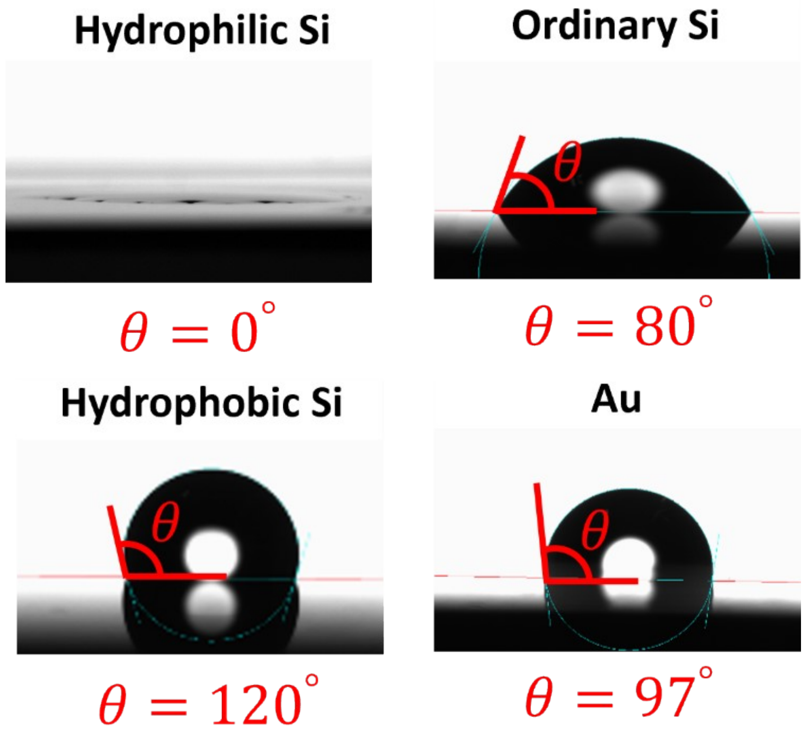


Figure S5. Water contact angle on the Si and Au surfaces.

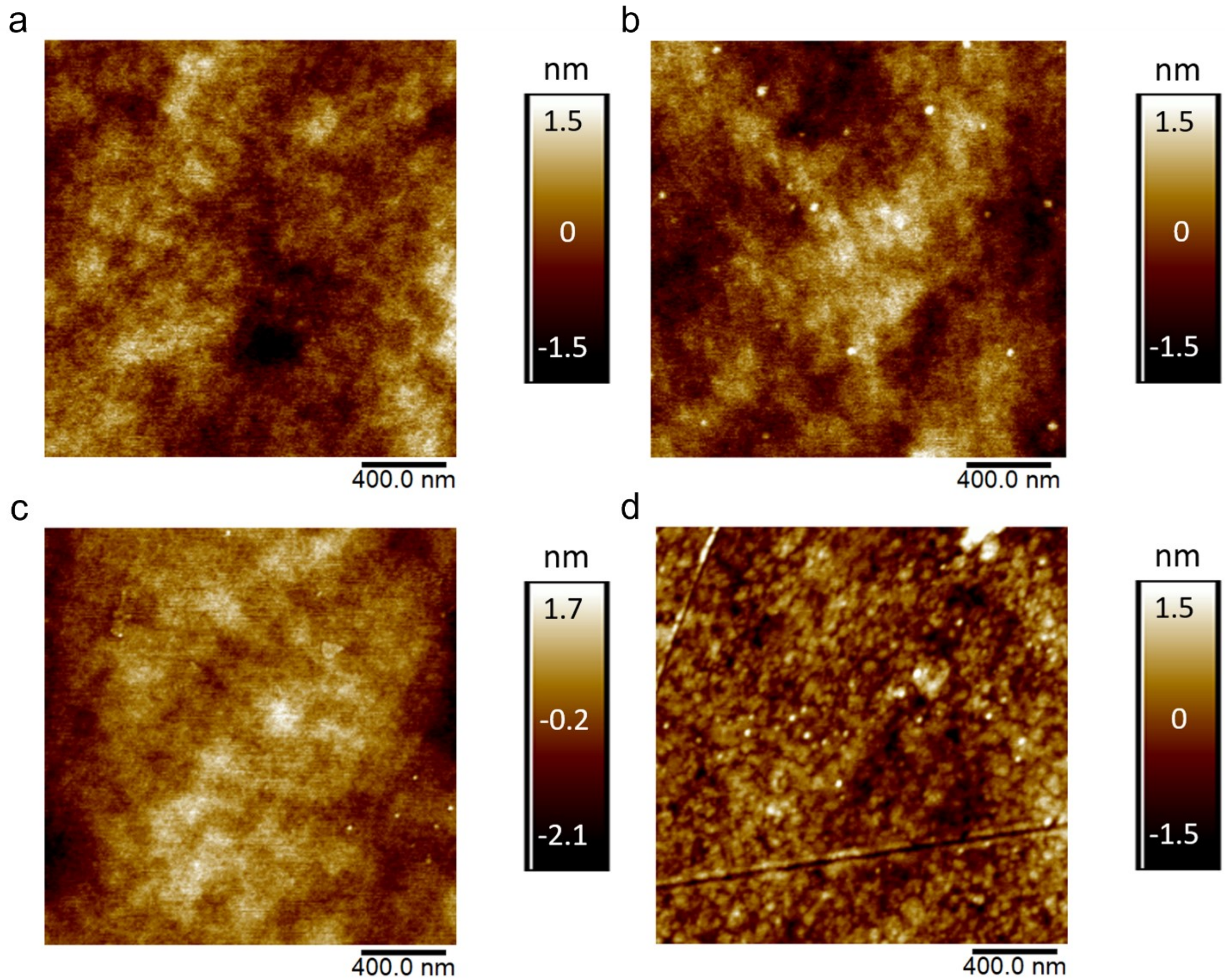


Figure S6. Topographic images of the Si and Au surfaces. (a) The hydrophilic n-type Si surface. (b) The ordinary n-type Si surface. (c) The hydrophobic n-type Si surface. (d) The Au surface.

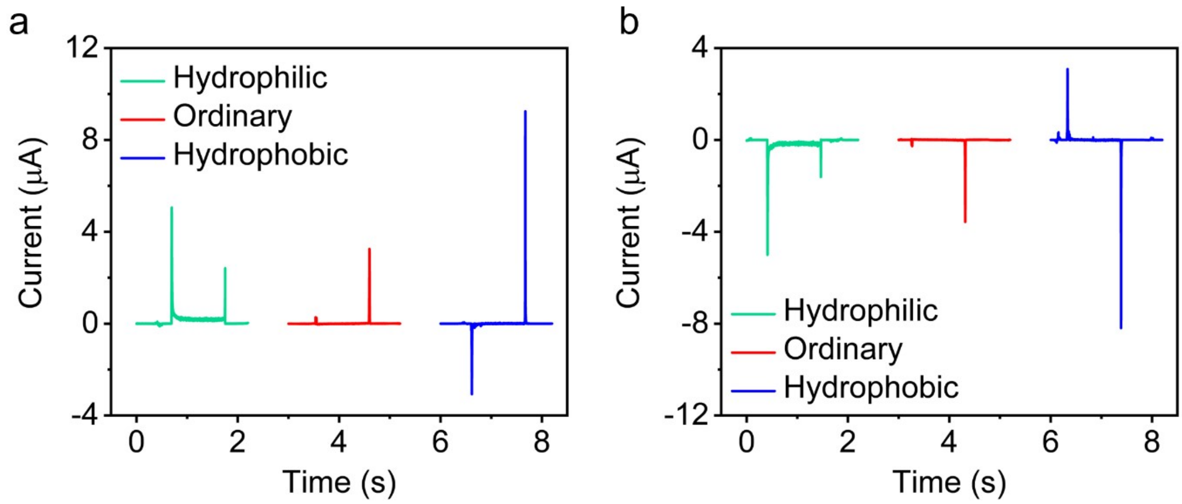


Figure S7. Switching polarity test of the intermittently contacted Au-H_2O-Si junctions. (a) The Au and Si friction layers were connected with the positive and negative probes of the system source meter. (b) The Si and Au friction layers were connected with the positive and negative probes of the system source meter.

Variable capacitance method:

The Au and Si friction layers were loaded to the translation stage and immovable holder, respectively. A current meter and voltage source were connected in series between the Au and Si electrodes, as shown in Figure S4a. The common connection between the voltage source and current meter was grounded. The applied voltage was swept with each increment of $10\ mV$ and, in the meantime, the gap d between the Au and the Si surfaces was modulated from $0.5\ mm$ to $2.0\ mm$ to generate an alternating pulse current in the external circuit. The voltage at which the minimum peak-to-peak current pulses occurred was taken as the chemical potential difference V_B.

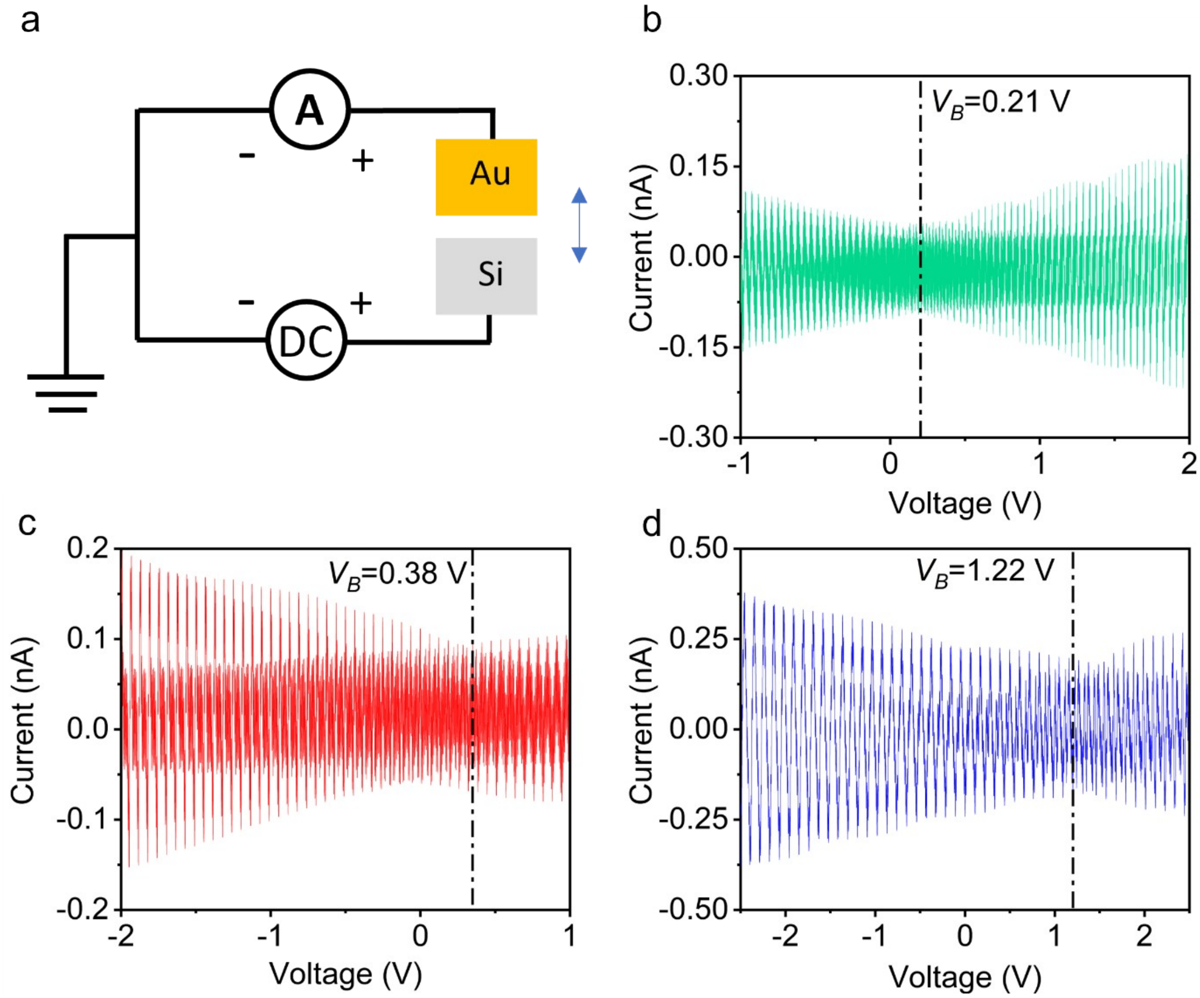


Figure S8. Chemical potential difference between the Au and Si surfaces. (a) The circuit schematic of the variable capacitance method. (b) The Au & Hydrophilic n-type Si friction pair. (c) The Au & Ordinary n-type Si friction pair. (d) The Au & Hydrophobic n-type Si friction pair.

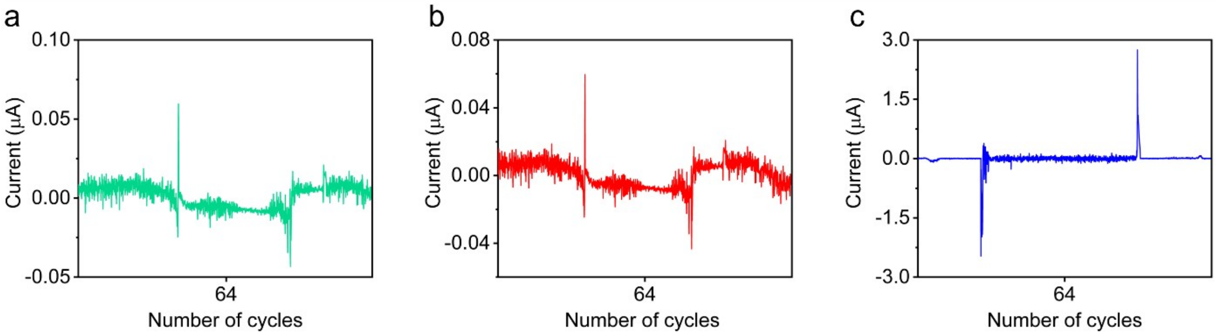


Figure S9. Short-circuit current of the intermittently contacted Au-H_2O-Si junctions from the 64th cycles. (a) The hydrophilic Si surface. (b) The ordinary Si surface. (c) The hydrophobic Si surface.

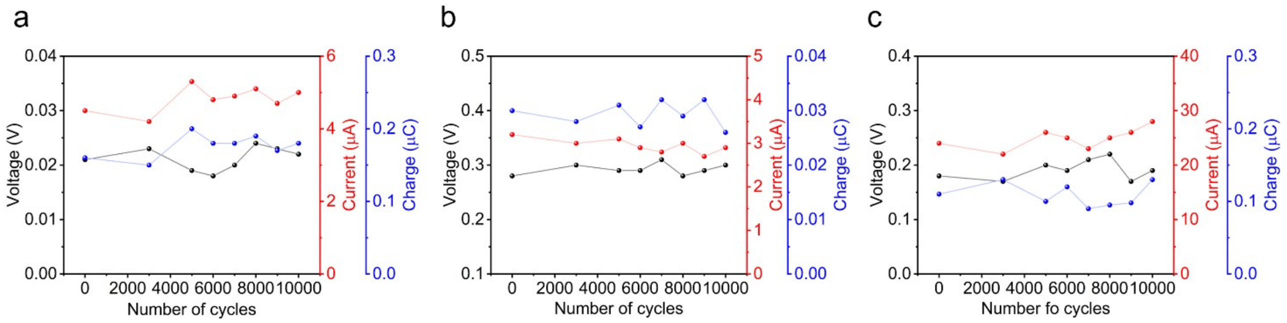


Figure S10. Output electric characteristics of the intermittently contacted Au-H_2O-Si junctions under humidifier spraying DI water mist. (a) The hydrophilic Si surface. (b) The ordinary Si surface. (c) The hydrophobic Si surface.

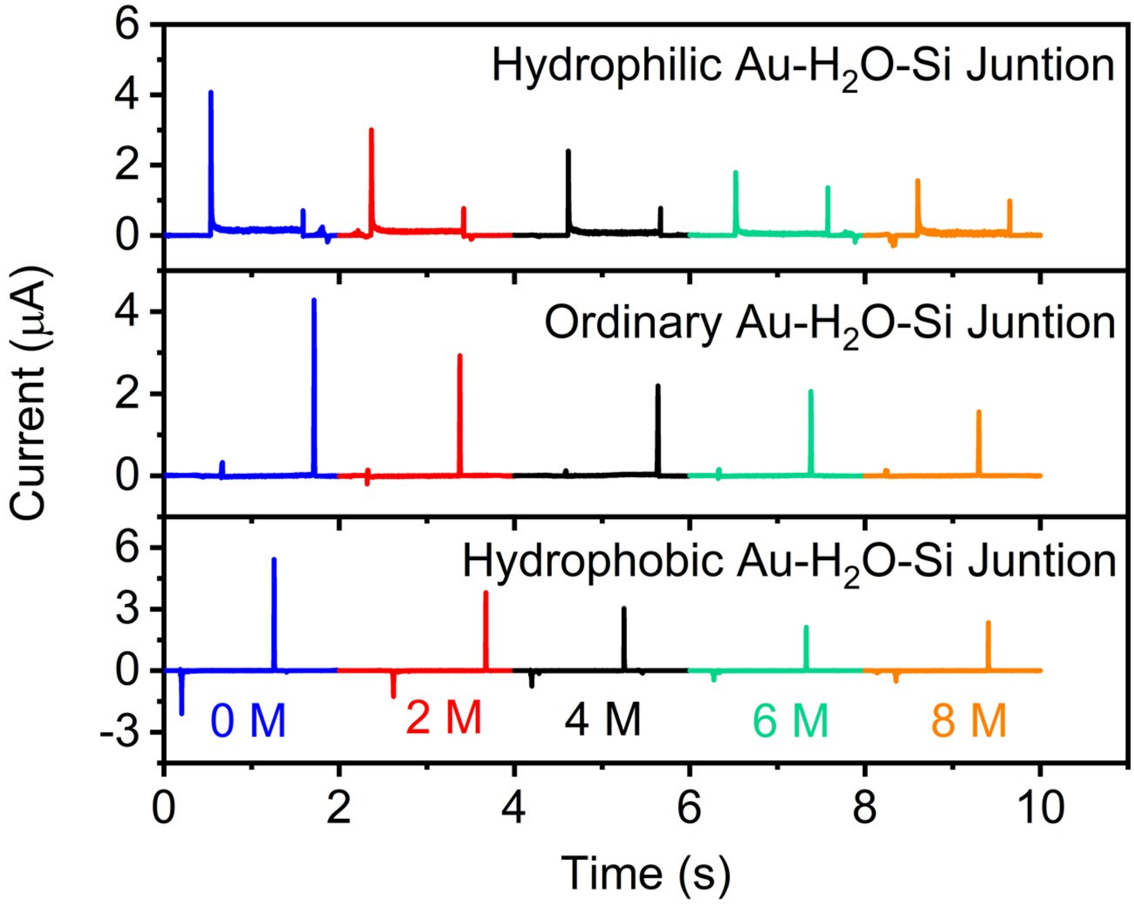


Figure S11. Output currents with different external loads of the intermittently contacted Au-H_2O-Si junctions.

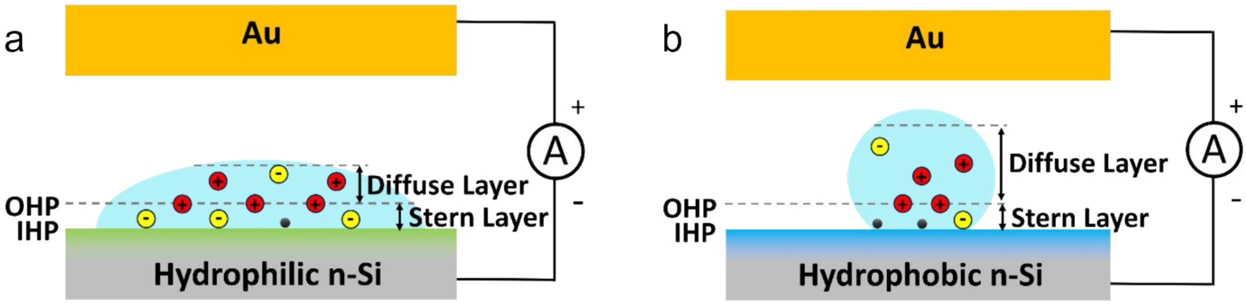


Figure S12. Illustrations for formation of electric double layers on the Si electrode surface. (a) The hydrophilic Si surface. (b) The hydrophobic Si surface. (IHP: Inner Helmholtz plane, OHP: Outer Helmholtz plane)

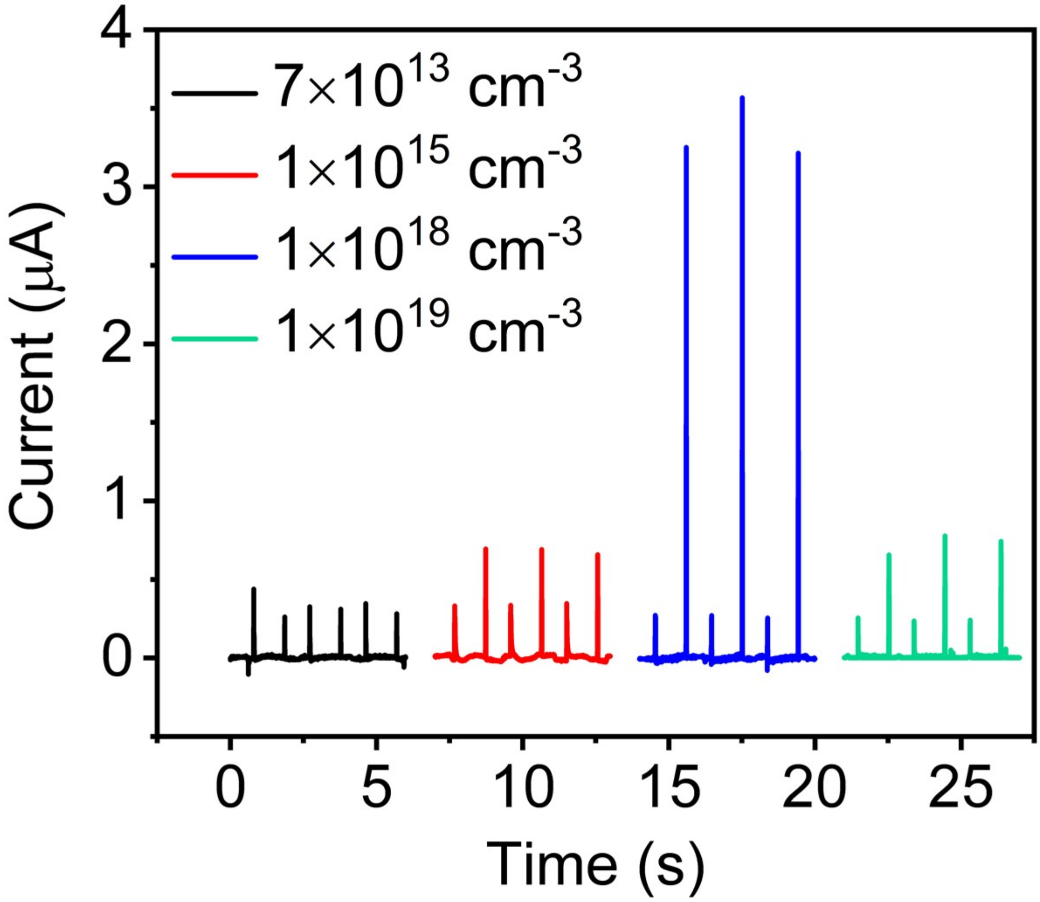


Figure S13. Short-circuit current of the intermittently contacted ordinary Au-H_2O-Si junctions with different doping concentrations of Si friction layers.

Table S1. Integrate charge of the Au-Si junctions.

Au-Si Junction	(nC)	Hydrophilic	Ordinary	Hydrophobic
Nonideal contact	Q_A	1.1	0.9	− 0.5
	Q_S	− 1.6	− 1.0	0.9
Ideal contact	Q	3.0×10^4	2.0×10^4	1.2×10^4