Electronic Supplementary Information

Electrically Configurable SERS-FET for the Highly Sensitive and Selective Detection of Molecules

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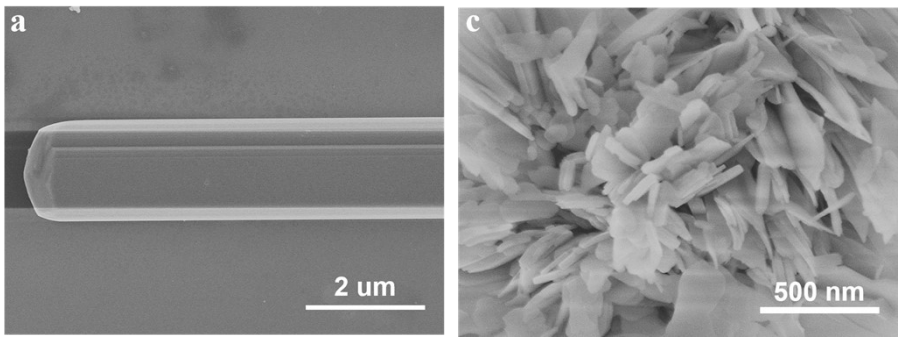

Fig. S1 SEM images of (a) the bulk MoO_3; (b) Li_x-MoO_{3-x}.

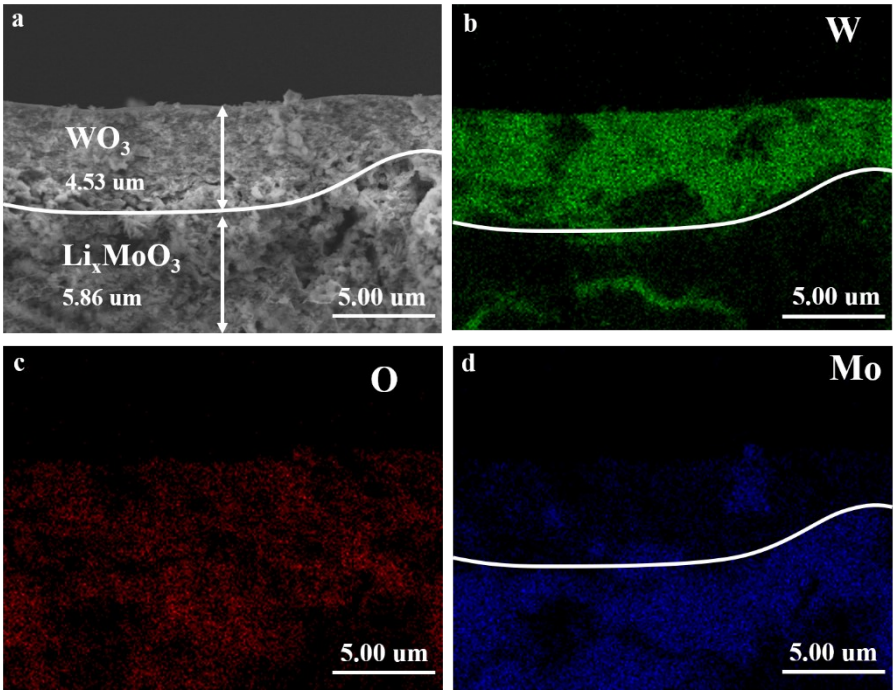

Fig. S2 Cross-sectional SEM image of the device. (a) Thickness of Li_xMoO_3 layer and TugO3 layer; (b)-(d) EDX mapping of the cross-sectional SEM image.

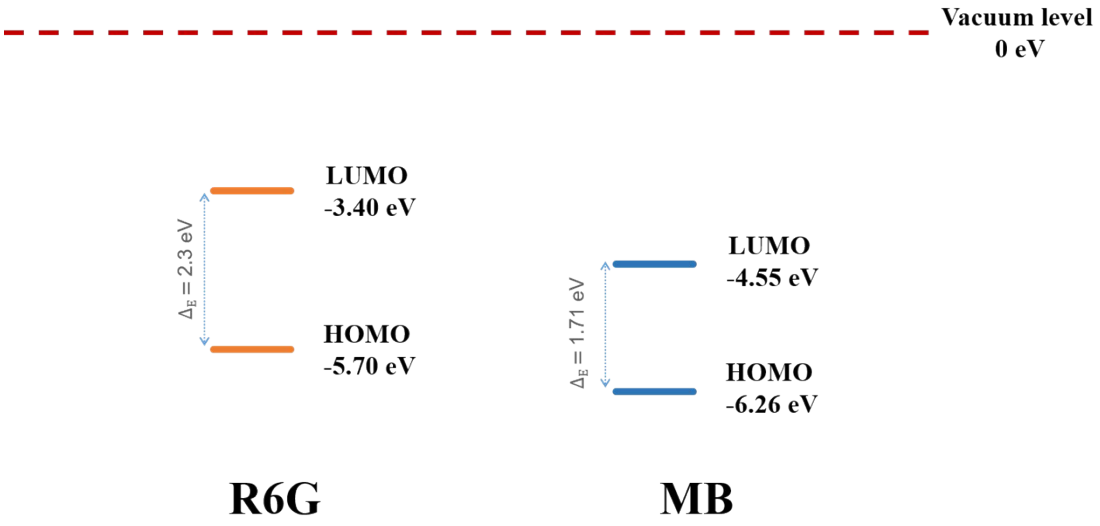

Fig. S3 Molecular orbitals of R6G and MB. All energies refer to the vacuum level.

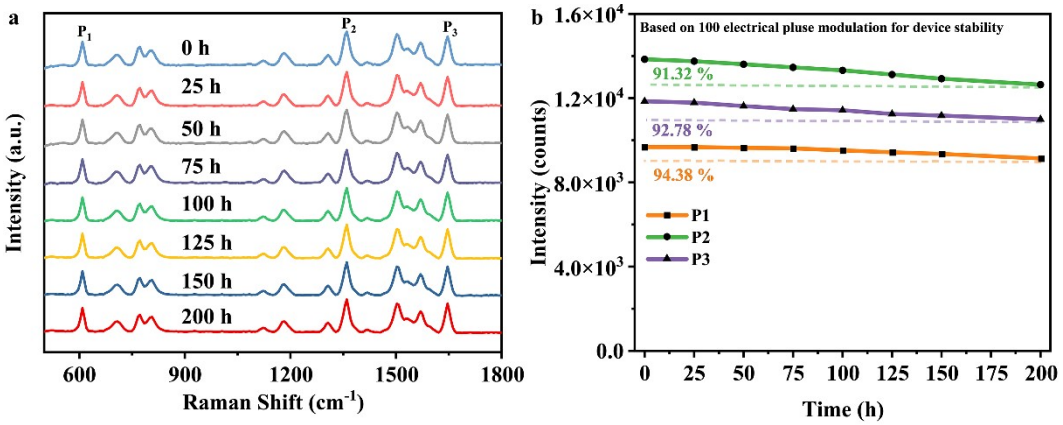

Fig. S4 (a) Raman spectra detected on the programmed device with different retention time. (b) Corresponding peak intensities extracted from the Raman spectra.

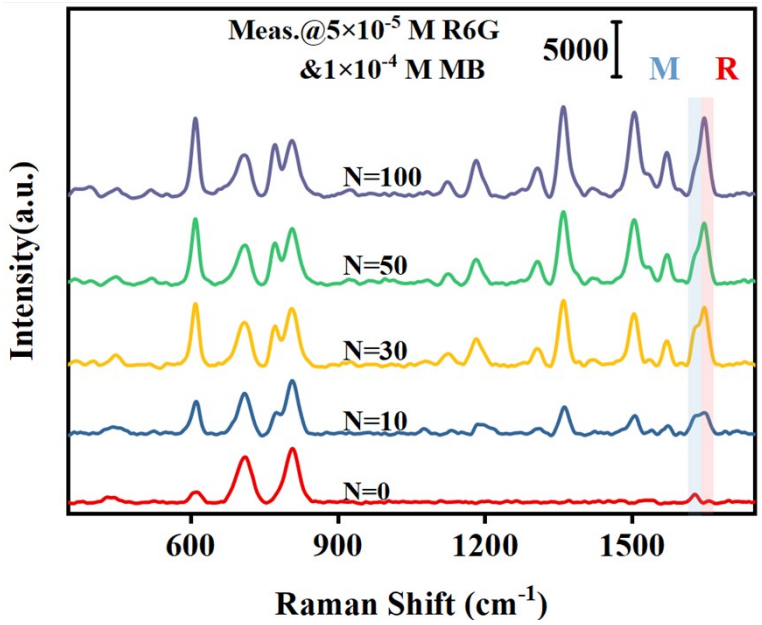

Fig. S5 Full SERS spectra of the R6G and MB mixed solution detected on the FET.

Calculation of enhancement factor: The SERS enhancement factor is calculated according to the following formula:

$$EF = \frac{I_{SERS} \times N_{bulk}}{I_{bulk} \times N_{SERS}} \quad (1)$$

where I_{SERS} is the integral intensity of the characteristic peak of *R6G* measured on the *SERS* substrate, I_{bulk} is the integrated intensity of the characteristic peak of the saturated *R6G* measured on a non-*SERS* substrate (silicon substrate), N_{SERS} is the number of molecules adsorbed on *SERS* substrates, and N_{bulk} is the number of molecules detected on non-*SERS* substrates.

To calculate this N_{bulk}, in the first step, we dropped 20 uL of 10^{-1} M *R6G* ethanol solution onto the silicon wafer, letting it diffuse naturally and dry in air for 2h. The radius *R* of the circle used to measure the diffusion area *S* of the R6G after drying is about 12.5 mm. Therefore, the coverage area *S* of R6G can be calculated based on the following formula:

$$S = \pi \times R^2 \quad (2)$$

Then, the parameters during *SERS* measurement are set as follows (532 nm excitation source, 1 mW laser power, 10 s integration time, laser spot radius 6.25 μm and 100× objective lens), and the N_{bulk} equation can be calculated based on the following equation:

$$N_{bulk} = c \times V \times \frac{\pi r^2}{\pi R^2} N_A \quad (3)$$

where *c* is the concentration of R6G, *V* is the volume of R6G solution dropping on the surface of the silicon surface, *r* is the radius of the laser spot, and N_A is the Avogadro constant. Given These parameters, N_{bulk} = 1.204×10^{11}.

N_{SERS} was calculated using the same method, briefly, 10 uL of 0.01 mM R6G ethanol solution was dropped on the SERS substrate and air-dried. The width of the middle channel micro-region of the customized device is *L* = 0.2 mm, so the Raman spot area is the actual measurement area. Based on the Equation (3), N_{SERS} = 1.505×10^6.