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Supporting Information

Multisensory neurons based on Fe_3O_4/graphene transistors for neuromorphic computing

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Figure S1 shows that schematic diagram of Fe_3O_4/graphene device with ionic liquid (IL) electrolyte. The gate, source and drain electrodes are denoted as G, S and D, respectively. The conductance of the channel was measured between S and D electrodes with a two-probe configuration by Keithley 2400 source meter and the read voltage between the source and drain is 0.1 V. The gate voltage (V_G) is applied between G and D and the leakage current (I_G) is measured between G and D electrodes. Figure S2 shows that the I_G versus V_G curve, where I_G (on the order of 10^{-11}–10^{-8} A) is negligible compared with current in the channel current (I_{SD}) (on the order of 10^{-7}–

10^{-6} A), suggesting that the leakage current cannot influence the measurement of channel conductance.

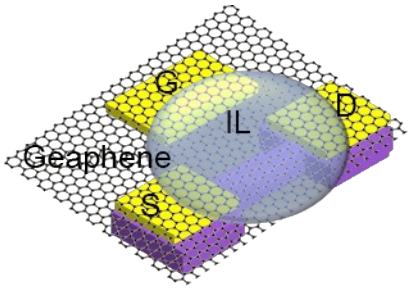

Figure S1 Schematic diagram of Fe_3O_4/graphene device with ionic liquid (IL) electrolyte.

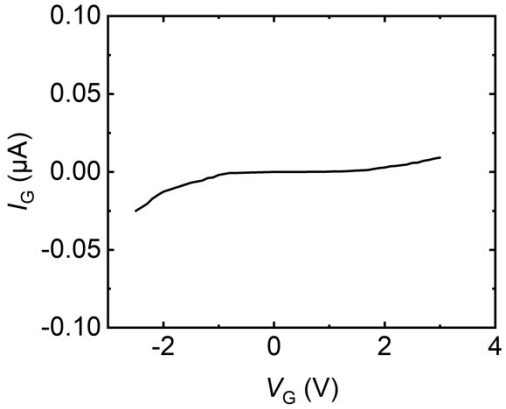

Figure S2 Gate voltage-dependent I_G curve during ion liquid gating in Fe_3O_4/graphene device.

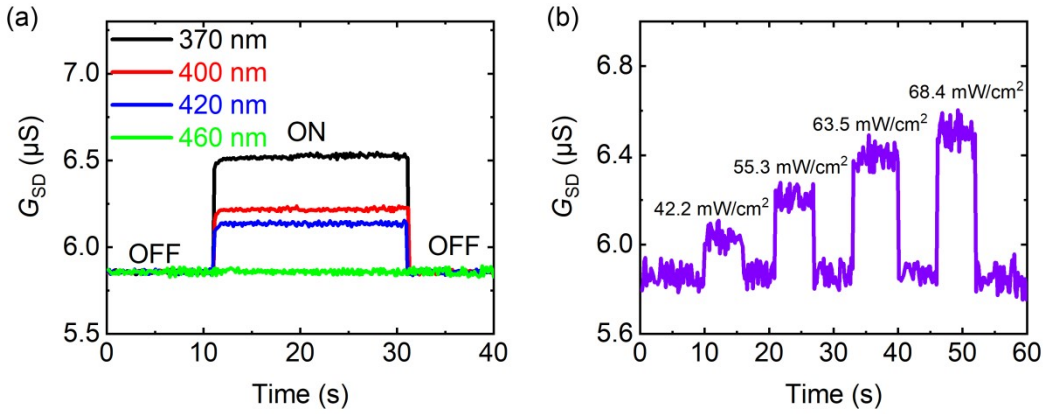

Figure S3 (a) The response of the channel conductance (Fe_3O_4/graphene transistor) under light illumination at various wavelengths. (b) The response of the channel conductance under various intensities of ultraviolet light (370 nm) illumination.

Figure S3(a) shows the modulations of the Fe_3O_4/graphene channel conductance under lights

with various wavelengths. The applications of lights at 370 nm, 400 nm, and 420 nm induce the increaes of conductance from 5.86 μS to 6.52 μS, 6.21 μS, and 6.14 μS, respectively. But the light with larger wavelengh (460 nm) cannot change the conductance obviously. Figure S3(b) shows the response of the channel conductance to ultraviolet light (UV, 370 nm) illuminations of various intensities. When the radiation intensity of UV light is 42.2 mW/cm^2, 55.3 mW/cm^2, 63.5 mW/cm^2, and 68.4 mW/cm^2, the channel conductance increases from 5.84 μS to 6.03 μS, 6.20 μS,6.40 μS, and 6.49 μS, respectively. In Fe_3O_4/graphene transistors, the enhancements of conductance induced by UV light illumination at different wavelengths and intensities are volatile, which can be used to simulate short-term plasticity of synapse.

Figure S4 modulations of the Fe_3O_4 channel conductance under light illumination. Four samples are considerd here: the first one is the Fe_3O_4, the second one is Fe_3O_4 covered by graphene, the third is the Fe_3O_4 covered by IL and graphene (sample used in the main text), and the fourth one is Fe_3O_4 only covered by IL. All the samples show similar response to the light illumination, suggesting that the light induced conductance change is mainly contributed by Fe_3O_4 layer rather than IL or graphene.

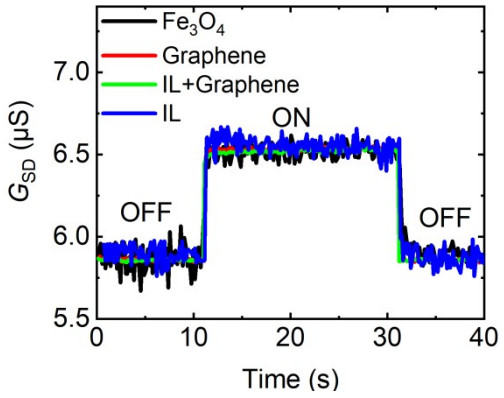

Figure S4 The response of the channel conductance under ultraviolet light (370 nm) illumination in Fe_3O_4 transistor covered IL and graphene, either or neither of them.