Supplementary Information

Inkjet-Defined Site-Selective (IDSS) Growth for Controllable Production of In-Plane and Out-of-Plane MoS₂ Device Arrays

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Figure S1. Residues deposited from a dried DI water droplet: (a) SEM of a substrate location with DI water droplet residues; (b) and (c) display the EDS spectra measured from the locations denoted by Arrows (1) and (2) in Fig. S1 (a), respectively.





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Figure S2. Transfer characteristic curves measured from all 16 MoS₂ FETs made from IDSSproduced in-plane MoS₂ pixel arrays. (V_{ds} = 3 V, V_g = -40 to 40 V).



Figure S3. Raman characterization of dispensed graphene flakes: (a) - (e) Raman spectra measured from five different graphene ink droplets dispensed and dried on the SiO₂/Si substrate; (f) I_D/I_G as a function of FWHM(G) calculated from Raman spectra.

Electrochemical impedance analysis of the MoS₂/graphene electrode

To characterize the electrochemical properties of our MoS₂/graphene electrode, impedance curves of before and after the 3 discharge/charge cycles were measured and plotted in the Fig. S3. The inset in the plot shows equivalent circuit model where R1, R2, R3 denote the internal resistance, solid electrolyte interface (SEI) resistance, and the charge transfer resistance. In addition, Q2, Q3 are constant phase element of SEI and the interface between the electrolyte and the active material. Finally, capacitance C4 and Warburg impedance W4 are assigned for before and after the cycling differently, because W4 is related to the lithium diffusion to the electrode.¹ By fitting the impedance plot, R1, R2, R3 values were extracted. During the 3-cycling test, the SEI resistance change is significant (from 1554 Ω to 4093 Ω), which could arise from the large surface area of out-of-plane MoS₂ structure. The charge transfer resistance of before and after the cycling are estimated to be 282.4 Ω , and 327.3 Ω , which are comparable to the value reported in the previous work.² The internal resistance R1 is calculated to be 43.5 Ω for both cases.



Figure S4. Impedance plot of before (Black dots) and after (Red dots) the 3 discharge/charge cycles measured from the out-of-plane MoS₂/graphene electrode by applying AC voltage with a

5mV amplitude over a frequency range of 0.5Hz to 1MHz; equivalent circuit models to the corresponding systems are shown in the inset.

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