Supporting Information

Stable Charge Storing in Two-Dimensional MoS_2 Nanoflake Floating Gates for Multilevel Organic Flash Memory

Minji Kang[a], Yeong-A Kim[a], Jin-Mun Yun[b], Dongyoon Khim[a], Jihong Kim[a], Yong-Young Noh[c]*, Kang-Jun Baeg[d]*, Dong-Yu Kim[a]*

[a]Heeger Center for Advanced Materials, Gwangju Institute of Science and Technology (GIST), 261 Cheomdan-gwagiro, Buk-gu, Gwangju 500-712, Republic of Korea

[b]Radiation Research Division for Industry and Environment, Korea Atomic Energy Research Institute (KAERI), Jeollabuk-do 580-185, Republic of Korea

[c]Department of Energy and Materials Engineering, Dongguk University, 26 Pil-dong, 3 ga, Jung-gu, Seoul 100-715, Republic of Korea

[d]Creative and Fundamental Research Division, Korea Electrotechnology Research Institute (KERI), 12 Bulmosan-ro 10beon-gil, Seongsan-gu, Changwon, Gyeongsangnamdo 642-120, Republic of Korea

*Correspondence: kimdy@gist.ac.kr, yynoh@dongguk.edu, kangjun100@keri.re.kr

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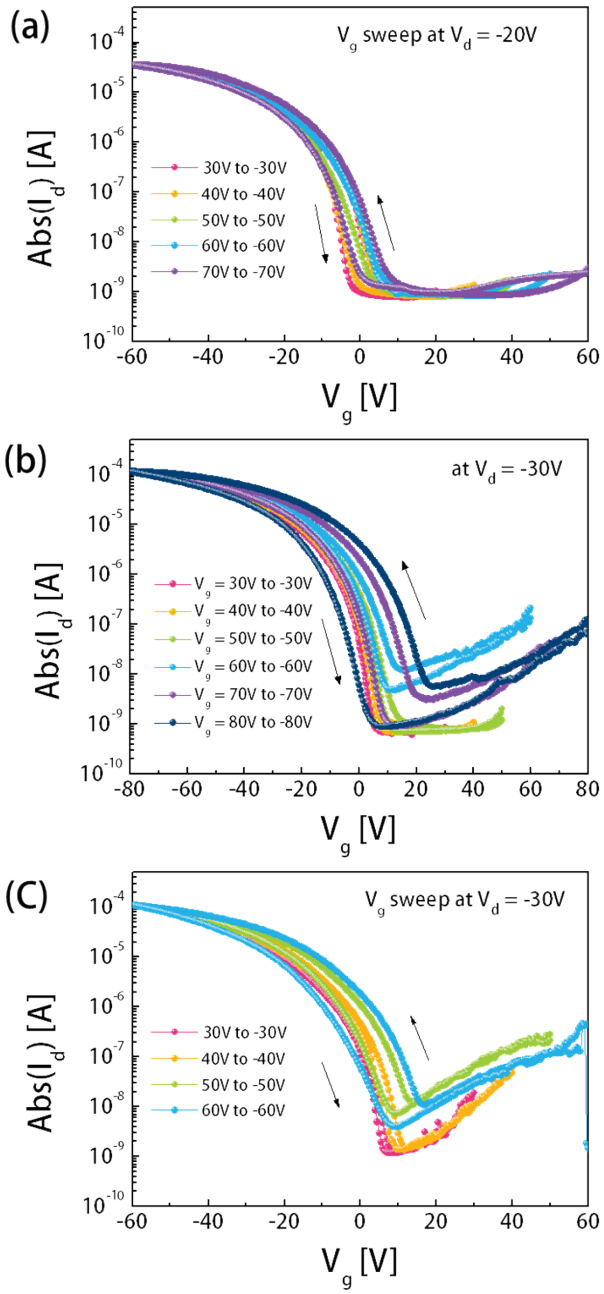

Figure S1. Transfer characteristics of memory devices depending on thickness of MoS_2 floating gate composed of (a) thinner nanoflakes, (b) optimized MoS_2 NFGs, and (c) thicker nanoflakes.

Memory characteristic measurement depending on thickness of MoS_2 floating gate

The characteristics of organic NFGMs were measured by varying the thickness of MoS_2 nanoflakes used as the floating gate (Figure S1). As shown in Figure S2(a), ONFGM with thinner MoS_2 nanoflakes (2–4-layered) than the optimized thickness (2–8-layered, Figure 4(c)) showed smaller memory windows. On the other hand, dielectric breakdown occurred more easily with increasing thickness of MoS_2 nanoflakes. ONFGM devices with >20-nm-thick MoS_2 nanoflakes showed dielectric breakdown upon the application of V_g sweep from 50 V to -50 V through the formation of an electrical short [Figure S2(b)]. An electrical short through the MoS_2 floating gate can be prevented by the optimization of its thickness, which can be achieved by adjusting the number of centrifuges or the concentration of suspensions used during the preparation of MoS_2 nanoflakes.

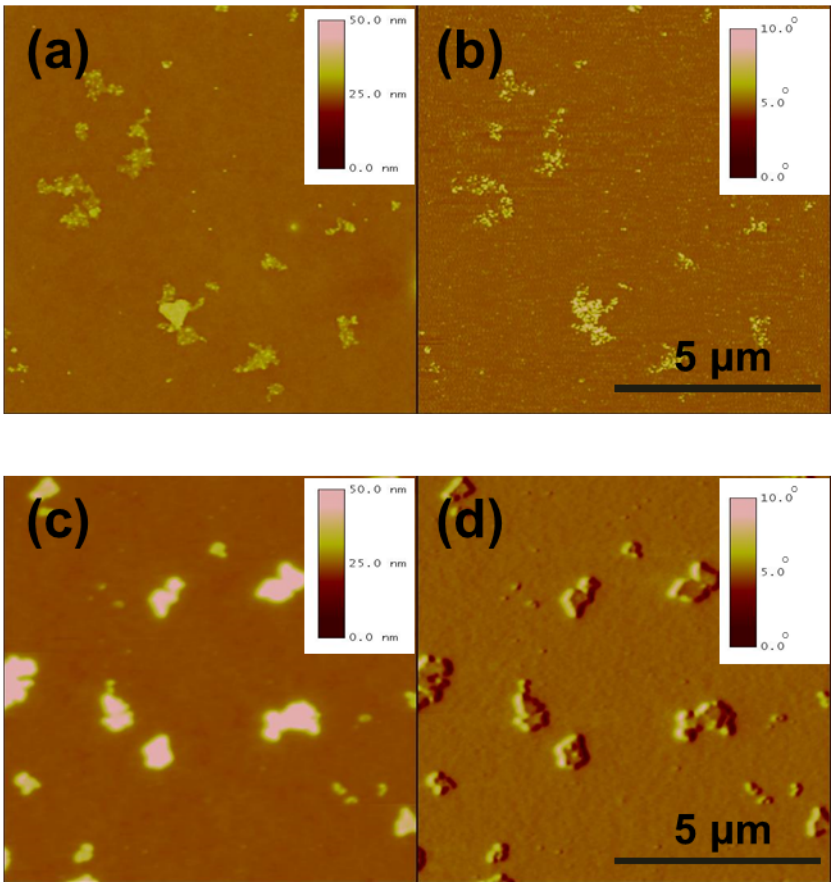

Figure S2. Tapping-mode AFM images of MoS_2 flakes in (a), (c) height and (b), (d) phase mode. Images of MoS_2 nanoflakes (a), (b) with a thickness of mostly 2–4 nm and (c), (d) 20–28 nm on a PS film.