Supporting Information

Two-dimensional molybdenum disulphide nanosheets covered metal nanoparticle array as floating gate in multi-functional flash memories

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Figure S1. Energy-dispersive X-ray spectroscopy (EDS) spectra of (a) Ag NPs (b) Au NPs and (c) Pt NPs.
Figure S2. SEM image of the MoS$_2$ nanosheets self-aligned on the Au NPs monolayer
Figure S3. The erasing operation of Ag NPs-MoS$_2$ memory device. The gate bias of erasing operation to release electrons after positively programming operation is -60 V for 5 s and the gate bias to release holes after negatively programming operation is +35 V for 1 s.
Figure S4. The erasing operation of Au NPs-MoS$_2$ memory device. The gate bias of erasing operation to release electrons after positively programming operation is -50 V for 1 s and the gate bias to release holes after negatively programming operation is +50 V for 1 s.
Figure S5. The erasing operation of Pt NPs-MoS$_2$ memory device. The gate bias of erasing operation to release electrons after positively programming operation is -30 V for 1 s and the gate bias to release holes after negatively programming operation is +60 V for 5 s.
Figure S6. Transfer characteristics of the standard FET devices under programming operation. The positively programming gate bias is set as +50 V for 1 s and the negatively programming operation is set as -50 V for 1 s.
Figure S7. Tapping-mode AFM height image of fabricated MoS$_2$ film for pristine MoS$_2$ flash memory.
Figure S8. Transfer characteristics of the memory devices with only Ag nanoparticles. The positively programming gate bias is set as +50 V for 1 s and the negatively programming operation is set as -50 V for 1 s.
Au NPs-MoS$_2$

**Figure S9.** $V_{GS}$ signals used for programming the flash memories into 8 data states (“0” to “7”) in Au NPs-MoS$_2$ flash memories.
Figure S10. $V_{GS}$ signals used for programming the flash memories into 8 data states (“0” to “7”) in Pt NPs-MoS$_2$ flash memories.
Figure S11. Data levels recorded for 100 sequential cycles of flash memories based on (a) Ag NPs-MoS$_2$ structure, (b) Au NPs-MoS$_2$ structure and (c) Pt NPs-MoS$_2$ structure.