Electronic Supplementary Material (ESI) for Chemical Communications

SUPPLEMENTARY INFORMATION

Effect of Redox Proteins on the behavior of Non-volatile Memory

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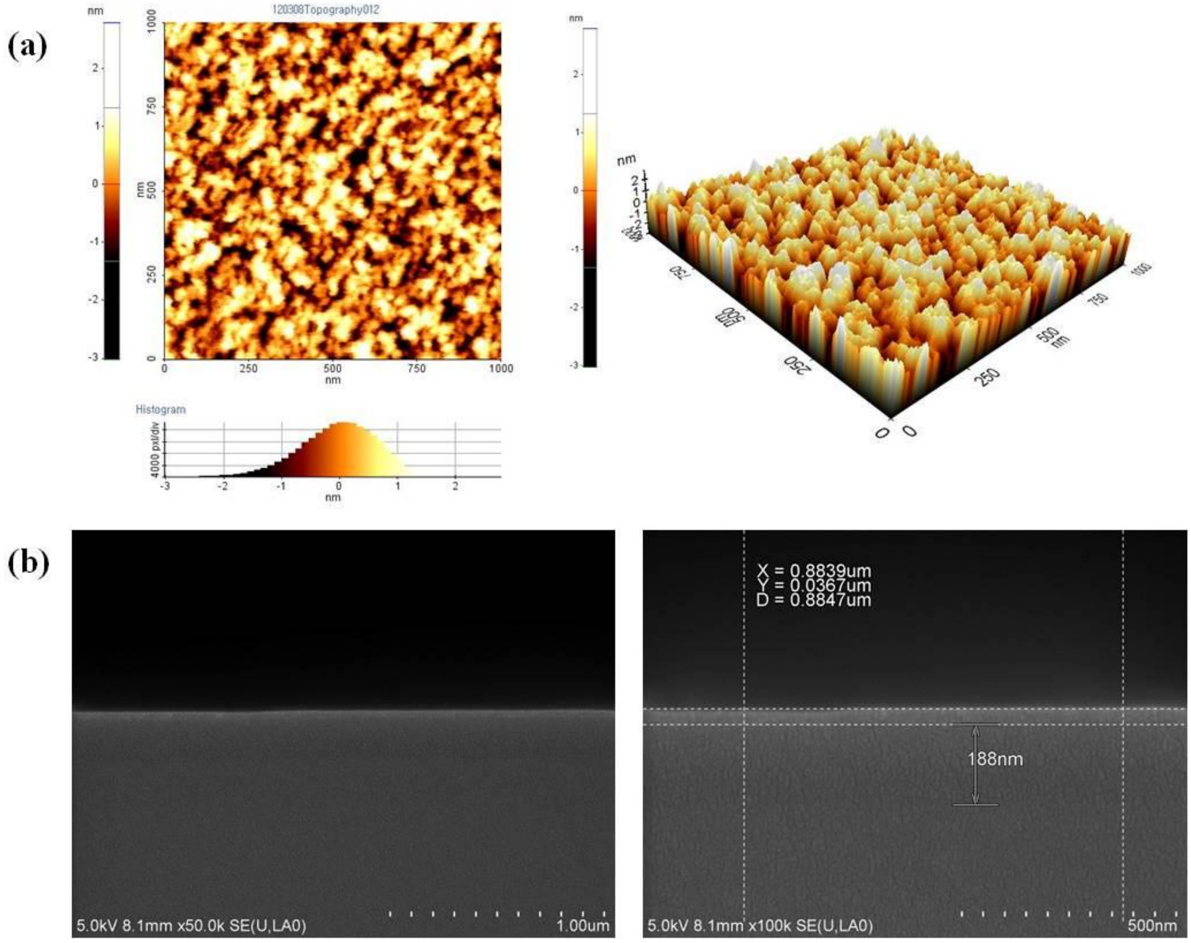

Fig. S1 (a) Atomic force microscopy images and (b) cross-sectional SEM images of a 0.5 mM myoglobin layer coated on a 200 nm SiO_2 substrate. The values of RMS roughness and the thickness of the myoglobin film were about 0.673 nm and 0.36 nm, respectively, as measured.

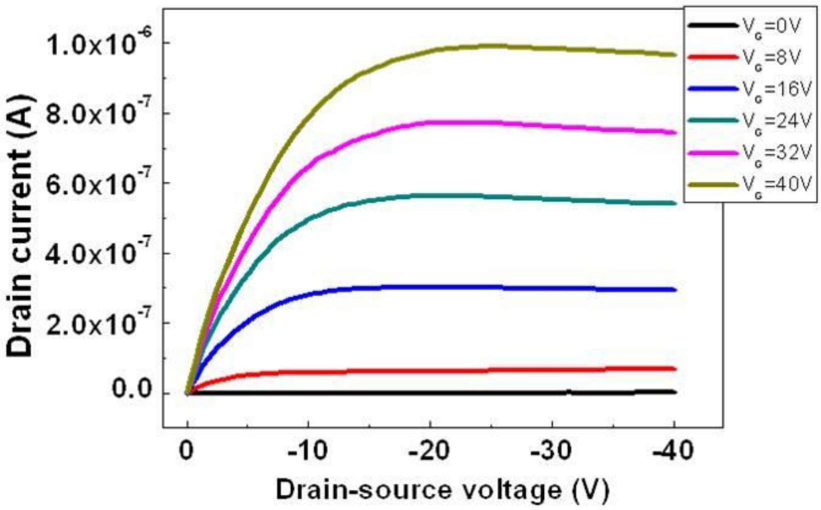

Fig. S2 Output curve for an OFET-based flash memory including a myoglobin chargeable layer prepared by spin coating from a 0.5 mM myoglobin solution with a pH 7.2 sodium buffer solution. The gate voltage ranged from 0 V to -40 V in 8 V steps.

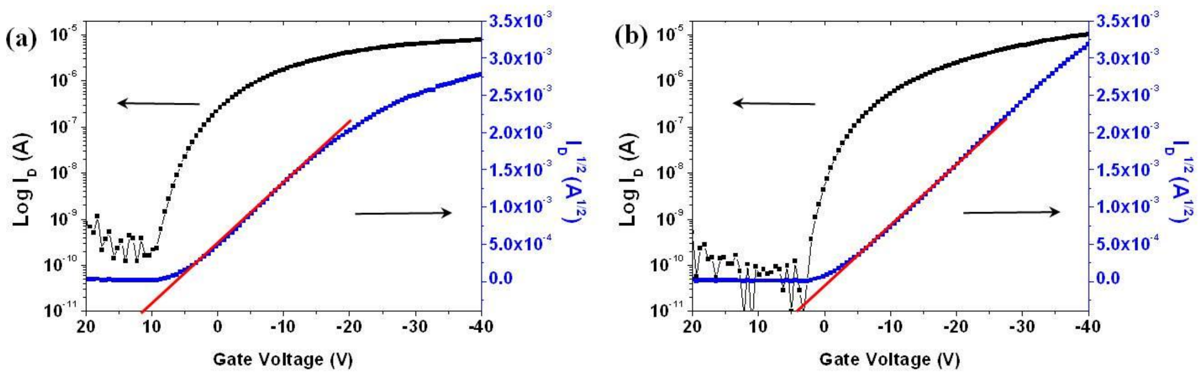

Fig. S3 The transfer characteristics of OFET-based flash memory (a) including the myoglobin charge trapping layer prepared using 0.5 mM myoglobin solution and (b) excluding the myoglobin charge trapping layer at V_D = - 40 V. The obtained field-effect mobilities of the OFET-based memories including/excluding the myoglobin layer were 0.0574 $cm^2\ V^{-1}\ s^{-1}$ and 0.0721 $cm^2\ V^{-1}\ s^{-1}$, respectively.

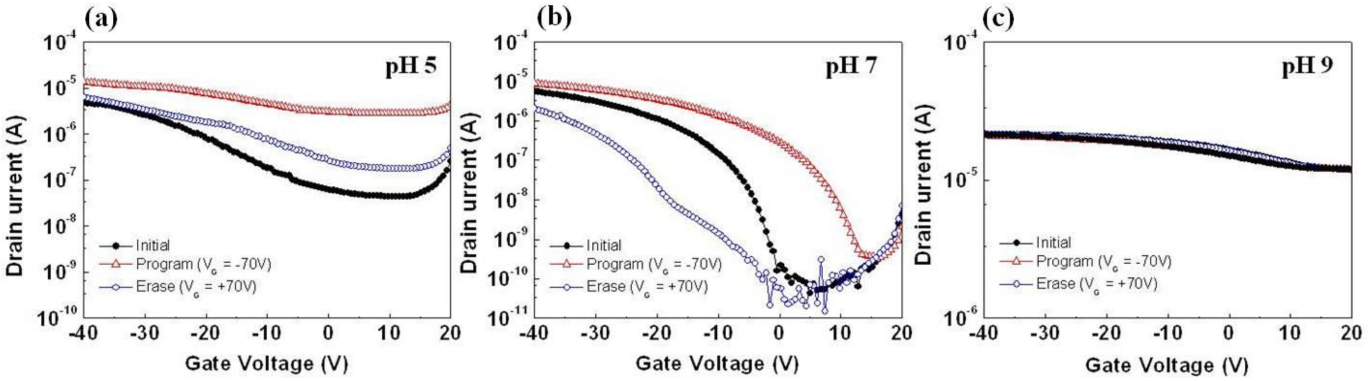

Fig. S4 The transfer characteristics of the fabricated OFET-based flash memory device with a myoglobin chargeable layer prepared using 1 mM myoglobin solution according to programming with -70 V for 2 s and erasing with +70 V for 2 s. The performances changed with pH of sodium buffer solution, specifically (a) pH 5, (b) pH 7 and (c) pH 9. A clear memory window and transfer properties were observed in the neutral state at pH 7. However, in case of acidic and basic states, the transfer properties of memory transistor were not shown owing to denaturation of proteins. In general, a change in pH can destroy the structure of proteins and cause denaturation. At the both acidic (pH 5) and basic (pH 9) states, the transfer characteristics were not shown or memory effects were disappeared because of the charge trapping ability degradation of redox proteins induced by the denaturation of proteins.

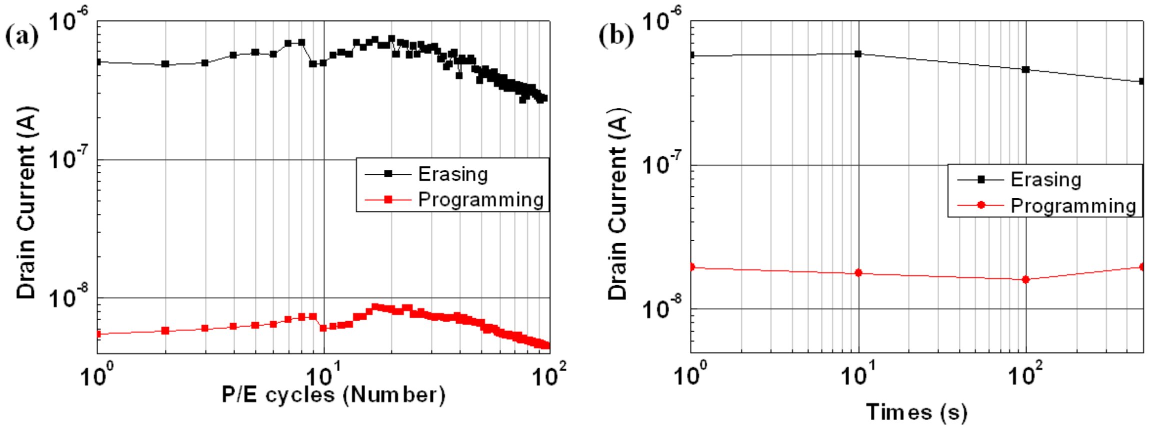

Fig. S5 (a) Endurance and (b) retention characteristics of memory transistor devices including myoglobin were measured at V_G = - 5 V and V_D = - 40 V after programming and erasing by the application of gate bias of -70 V and +70 V at V_D = - 0 V for 2 s.