Supporting Information

Advanced Photoassisted Atomic Switch Produced Using ITO Nanowire Electrodes and Molten Photoconductive Organic semiconductor for Intelligent Artificial Retina Devices

Annop Klamchuen,[†,‡] Hirofumi Tanaka[*,†], Daisuke Tanaka,[†] Hirotaka Toyama,[†] Gang Meng,[‡] Sakon Rahong,[‡] Kazuki Nagashima,[‡] Masaki Kanai,[‡] Takeshi Yanagida,[‡] Tomoji Kawai,[‡] and Takuji Ogawa[†]

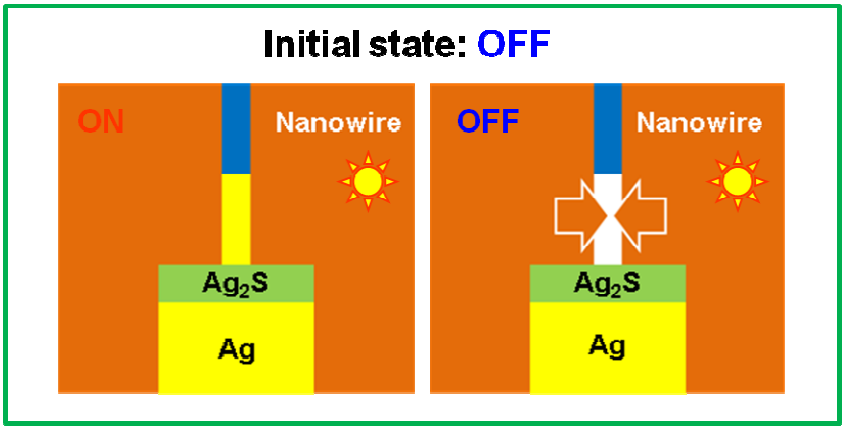
[1]Department of Chemistry, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan, [2]Institute of Scientific and Industrial Research, Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

*e-mail: tanaka@chem.sci.osaka-u.ac.jp

1. Initial state of photoassisted atomic switch (PAS) device before the observation of switching event

To be able to examine the filling of molten photoconductive material into the voids during the growth and shrinkage of Ag_2S/Ag, we disconnected the Ag conductive bridge from ITO nanowire electrodes by applying a negative voltage of 10 V to the Ag_2S/Ag electrode under light irradiation, as shown in figure S1a. This leads to an OFF state in the initial stage before investigating the *I-V* characteristics of PAS device. The time of disconnection of the Ag conductive bridge from ITO nanowire electrodes was about 25 s (Fig. S1b). The method employed to prevent the occurrence of the void is discussed in our manuscript. The schematic of the compensation mechanism using molten photoconductive material and the initial state of the PAS device are provided in Fig. S1a and b, respectively.

(a)



(b)

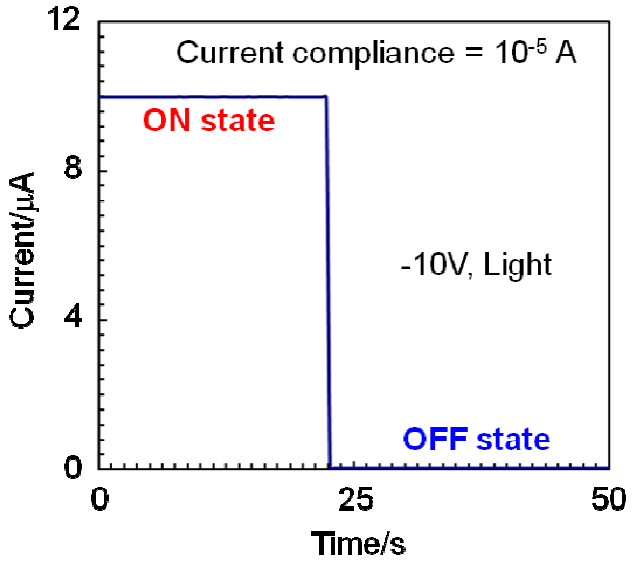


Figure S1. Initial state of PAS. (a) the schematic of the compensatory mechanism for the filling of voids during the shrinking of the Ag wire by using molten photoconductive material. (b)The disconnection of Ag conductive bridge from ITO electrode to obtain OFF state before the observation of PAS switching event, which was carried out by applying a negative bias of 10 V to the Ag_2S/Ag electrode under light irradiation. Note that the current compliance is limited to 10^{-5} A.

2. Data retention properties and continuous switching event of photoassisted atomic switch (PAS) device measured under vacuum ($P < 4.0 \times 10^{-4}$ Pa) at 300 K.

Figure S2a shows the data-retention time of PAS device. The measurements were carried out at 300 K under vacuum ($P < 4.0 \times 10^{-4}$ Pa) in the dark. The readout of the currents was performed at +5 V, which was applied to Ag_2S/Ag electrode. It should be noted that the current compliance is limited to 10^{-5} A. ON state (low resistance state) and OFF state (high resistance state) of PAS device is maintained for at least 3600 s, clearly indicating that our device can act as nonvolatile memory device. Figure S2b shows the continuous switching event of the PAS device. The observed switching cycle is 10 times under light irradiation. The switch was turned ON and OFF at approximately 7.7 and −6.7 V, respectively. The ON/OFF ratio is about 10^{-5} to 10^{-6}. These result confirmed that our PAS device is stable and can provide continuous switching.

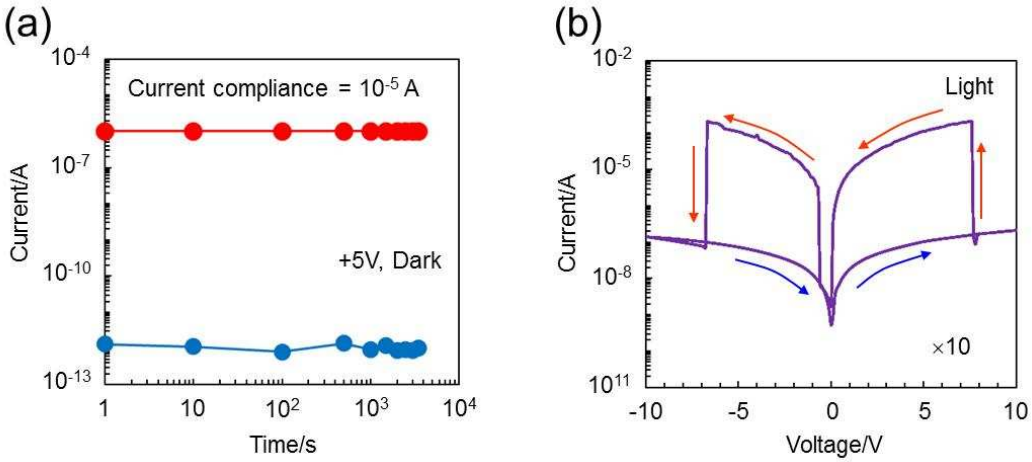


Figure S2. PAS switching. (a)data-retention time. (b)endurance of PAS measured under vacuum ($P < 4.0 \times 10^{-4}$ Pa) at 300 K.