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Boosting up the photoconductivity and relaxation time using a double layered indium-zinc-oxide/indium-gallium-zinc-oxide active layer for optical memory devices

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Solution-processed metal-oxide semiconductors have been considered as the next generation semiconducting materials for transparent and flexible electronics due to their high electrical performance. Moreover, since the oxide semiconductors show high sensitivity to light illumination and possess persistent photoconductivity (PPC), these properties can be utilized in realizing optical memory devices, which can transport information much faster than the electrons. In previous works, metal-oxide semiconductors are utilized as a memory device by using the light (i.e. illumination does the "writing", no-gate bias recovery the "reading" operations) [1]. The key issues for realizing the optical memory devices is to have high photoconductivity and a long life time of free electrons in the oxide semiconductors. However, mono-layered indium-zinc-oxide (IZO) and mono-layered indium-gallium-zinc-oxide (IGZO) have limited photoconductivity and relaxation time of 570 nA, 122 sec, 190 nA and 53 sec, respectively.

Here, we boosted up the photoconductivity and relaxation time using a double-layered IZO/IGZO active layer structure. Solution-processed IZO (top) and IGZO (bottom) layers are prepared on a Si/SiO2 wafer and we utilized the conventional thermal annealing method. To investigate the photoconductivity and relaxation time, we exposed 9 mW/cm2 intensity light for 30 sec and the decaying behaviors were evaluated. It was found that the double-layered IZO/IGZO showed high photoconductivity and relaxation time of 28 uA and 1048 sec.

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