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Metal Oxide Thin Film Transistor with Porous Silver Nanowire Top Gate Electrode for Label-Free Bio-Relevant Molecules Detection

유태희^{1,2}, 김정혁³, 상병인², 최원국^{3,*}, 황도경^{1,*}

¹Korea Institute of Science and Technology (KIST), Post-Silicon Semiconductor Institute

²Hanyang University, Department of Chemical engineering

³Korea Institute of Science and Technology, Materials and Life Science Research Division

Chemical sensors have attracted much attention due to their various applications such as agriculture product, cosmetic and pharmaceutical components and clinical control. A conventional chemical and biological sensor consists of fluorescent dye, optical light sources, and photodetector to quantify the extent of concentration. Such complicated system leads to rising cost and slow response time. Until now, the most contemporary thin film transistors (TFTs) are used in the field of flat panel display technology for switching device. Some papers have reported that an interesting alternative to flat panel display technology is chemical sensor technology. Recent advances in chemical detection study for using TFTs, benefits from overwhelming progress made in organic thin film transistors (OTFTs) electronic, have been studied alternative to current optical detection system. However numerous problems still remain especially the long-term stability and lack of reliability. On the other hand, the utilization of metal oxide transistor technology in chemical sensors is substantially promising owing to many advantages such as outstanding electrical performance, flexible device, and transparency. The top-gate structure transistor indicated long-term atmosphere stability and reliability because insulator layer is deposited on the top of semiconductor layer, as an effective mechanical and chemical protection. We report on the fabrication of InGaZnO TFTs with silver nanowire as the top gate electrode for the aim of chemical materials detection by monitoring change of electrical properties. We demonstrated that the improved sensitivity characteristics are related to the employment of a unique combination of nano materials. The silver nanowire top-gate InGaZnO TFTs used in this study features the following advantages: i) high sensitivity, ii) long-term stability in atmosphere and buffer solution iii) no necessary additional electrode and iv) simple fabrication process by spray.

Keywords: Silver Nanowire, Metal oxide semiconductor, Field effect transistor, and Portable and Non-destructive Sensing Platform