[WP1-108]

Comparative study on the structural dependence of the sensitivity InGaZnO photosensors

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Upon the advent of wearable IoT era, the flexible/stretchable media-compatible technology which is viable for the integration of the transistor and sensor devices with only one material becomes urgently required. Based on this motivation, the amorphous InGaZnO (a-IGZO) is a significantly promising material with many advantages such as quite high mobility, low process temperature, large-area uniformity, transparency in visible light range, compatibility with flexible/stretchable media, the photo-sensitive current, and already mature and stable transistor characteristics [1]. However, the possibility of a-IGZO as photosensor device is significantly compromised by the persistent photoconductivity (PPC) under photo-illumination [2]. In this work, the comparative study on structural dependences of the photocurrent and its sensitivity of a-IGZO photosensors is carried out.
Three kinds of structures, such as thin-film transistor (TFT), local metal-semiconductor-metal (LMSM), and global metal-semiconductor-metal (GMSM) are studied. While in the case of TFT, the ohmic contact is formed between a-IGZO active and Ti source/drain (S/D) electrode, Schottky back-to-back contact is formed between a-IGZO active and Au electrode in either LMSM or GMSM [Fig. 1 (a)-(c)]. We find that no PPC is observed in either LMSM or GMSM, whereas the well-known PPC occurs in TFT structure [Fig. 1 (d)]. The suppression of PPC in MSM structures is due to a much smaller volume of photon-injected region in MSM compared with TFT structure. It is also found that the photo-illumination in both the top electrode (TE) and a-IGZO film (in the case of GMSM) dramatically improves the sensitivity, which is defined by the current difference between a dark and light conditions, of a-IGZO photosensors in comparison with the case of photo-illumination only in TE (LMSM) [Fig. 1(d)]. Our result is potentially useful for the structural design of a-IGZO-based photosensors in wearable IoT era.

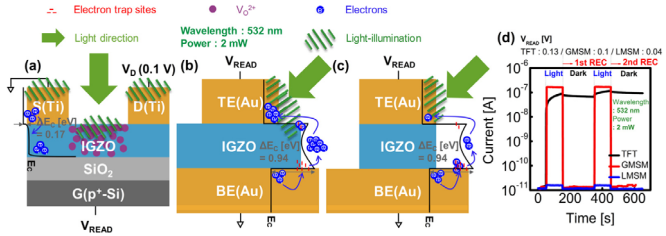

Fig. 1. Schematic cross-section of the a-IGZO photosensors with (a) TFT, (b) GMSM, and (c) LMSM structures. The line indicates the conduction band minimum(E_C). (d) Measured current during the repetitive light ON/OFF sequence.

Reference

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[WP1-109]

Characteristics of Hydrogen ion sensitive transistor fabricated on university CMOS fab

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n채널 p-well CMOS 기술로 구현된 소자는 inter-digit형 구조로 제작된 반도체형 수소이온센서의 수소이온 감지특성을 평가하였다. 실험실 공정을 이용하여 소자는 n형 (100) 4인치 웨이퍼로 제작되었다. 테이프 아웃 후 제안된 소자는 n tye wafer를 이용해 2.5um 디자인 룰을 적용 하여 제작하였다. 설계의 핵심인 gated LBJT에서의 이온을 감지하는 부분인 게이트에 대한 설계는 open gate로 설계하였다. Inter-digit형소자를 제작하여 pH 응답 특성을 확인하였다. open-gate 방식의 LPCVD로 형성된 양질의 질화막을 사용할수 있으며 소자에 맞춰 제작공정을 변경할수 있다는 장점이 있었다. 제작 완료된 소자의 센싱부 절단면은 그림에 나타나 있다. 베이스 전류의 영향에 대한 측정을 하였다. 이때 게이트 전압은 3V로 고정된 상태이다. 먼제 IB가 100uA일때는 순방향 바이이스의 하이브리드 모드로서 동작하여 출력전류가 높았다. 다음으로 베이스 전류가 0일때 즉 MOS에 가깝게 동작하였으며 게이트전압이 문턱전압이사이라 ISFET와 유사한 특성을 나타냈다 마지막으로 베이스 전류가 -100uA일때는 순 MOS상태라 바이어스 조건이 맞지 않아 수소이온을 감지하지 못하였다.

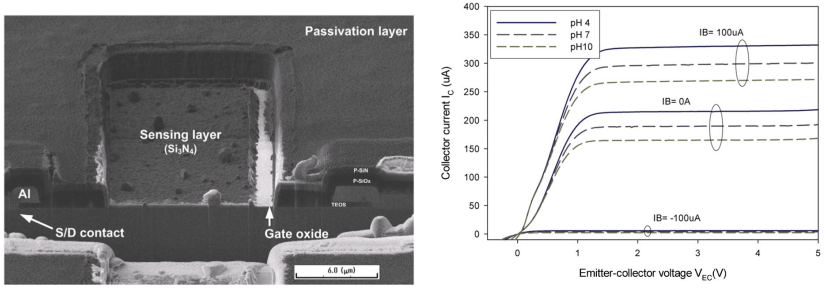

Fig. 1. SEM image of n-kFET cut by FIB in around sensing region.(reft), IC-VEC according to change of pH and base current..(right)

[1] Il-Seok Son, Amit Lal, Bill Hubbard and Tim Olsen, "A multifunctional silicon-based microscale surgical system", Sensors and Actuators A: Physical, Vol. 91, Issue 3, pp. 351-356, 2001.