Silicon-doped indium oxide thin-film transistor fabricated via spin coating

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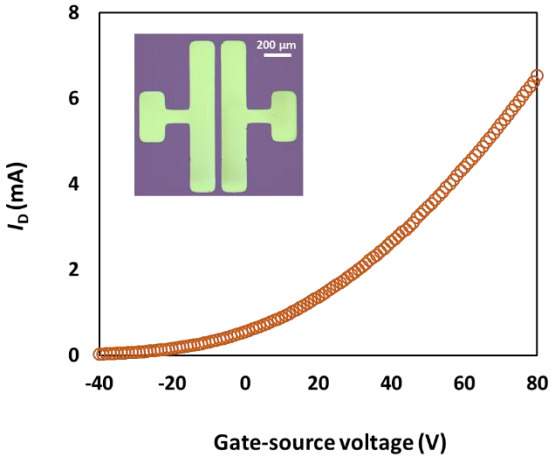
The excellent report on In-Ga-Zn-O system by Prof. Hosono group has opened a new era of flat panel displays using thin-film transistors (TFTs) with amorphous oxide semiconductors as channel [1-2]. Among many amorphous oxide semiconductor materials, silicon-doped indium oxide (In-Si-O or ISO) is an attractive material because of its high reliability due to the strong bonding energy between Si and O (799 kJ mol^{-1}) compared to bonding energy between In and O (346 kJ mol^{-1}) [3]. According to synchrotron radiation analysis on structure of ISO, it suggested that even a small amount of Si atoms is enable to deform InO_x polyhedral and stabilize amorphous phase [4-6], contributing to high performance of ISO TFTs. The sputtered ISO TFT exhibited great value of mobility around 10 to 20 cm^2/Vs without significant degradation [7-8]. In addition, solution process owns several advantages compared to physical vapor deposition such as simple process, inexpensive equipment, low waste material, and easy to control the film quality. Therefore, we have investigated on solution-processed ISO TFT through spin coating method [9-10]. By examining ISO thin films under x-ray reflectivity and x-ray diffraction, the film thickness, density, roughness and crystallinity were optimized to find the best fabrication condition for TFT. Besides, ageing effect, annealing temperature and annealing environment were also studied to understand the influence of those factors on the device operation. At the moment, we have achieved the highest mobility of 8.07 cm^2/Vs with the sample annealed at 400 °C in oxygen environment. Further improvements are also regarded to satisfy the operation to meet the requirement of high definition flat panel display.



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