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ZnO:F films by magnetron sputter-deposition: A comparison of fluorine sources between ZnF_2 containing targets and CF4 containing gas mixtures

김용현, 구대영*, 윤희성**, 이경석***, 이택성***, 정병기***, 성태연, 김원목***,†

고려대학교 신소재공학과; *일동 화학; **LG 마이크론; ***한국과학기술연구원 박막재료연구센터

(wmkim@kist.re.kr†)

Recently, doped ZnO films have drawn much attention as an alternative transparent conducting oxide (TCO) for Sn doped In_2O_3 (ITO) due to the cost effectiveness combined with abundance of raw material and their electrical and optical characteristics comparable to ITO. Although fluorine is also a potential candidate for dopant to ZnO, unlike cationic dopants such as Al, Ga and H, studies on the fluorine doped ZnO (FZO) films, especially, films deposited by using a physical vapor deposition technique like magnetron sputtering, are rare.

In this study, FZO films were deposited by radio frequency (rf) magnetron sputtering on Corning glass (Eagle 2000) substrates, and the electrical, optical and compositional properties of the as-deposited and the vacuum-annealed (at 300 °C) FZO films were examined. Doping of fluorine was made by using two methods; (1) by sputtering of ZnO targets containing ZnF_2 with pure Ar gas, and (2) by sputtering pure ZnO target in Ar/CF_4 gas mixtures. For both sets of the as-deposited FZO films, the fluorine contents increased monotonically with increasing ZnF_2 content in target and CF_4 flow rate in sputter gas mixture. Their behaviors of electrical properties with respect to fluorine content in films were similar, in that the free carrier number and the Hall mobility exhibited a maximum and a minimum behavior, respectively. Upon annealing in vacuum, however, the improvement in electrical properties was attained via different ways; (1) by rising of the free carriers as well as the Hall mobility for films deposited from ZnF_2 containing target, and (2) by a large increase in the Hall mobility with a little change in carrier concentration for films fabricated by using CF_4 gas. Also, appreciable differences in the optical and the structural properties were noticed, indicating that the two different fluorine sources might cause different growth modes as well as different states of the incorporated fluorine.

Keywords: Fluorine doped ZnO film, Transparent conducting oxide, Magnetron sputtering, Vacuum-annealing

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Photo-patternable Methacrylate Hybrid Materials as Gate Dielectrics in Organic Thin Film Transistors

최천기, 서석준, Dan Zhao, 배병수†

한국과학기술원

(bsbae@kaist.ac.kr†)

Organic thin film transistor (OTFT) has attracted much attention because of the processability, low cost, and flexibility. Sol-gel derived organic-inorganic hybrid materials (hybrimers) are potential candidates of gate insulators in OTFTs due to the solution processibility, and the easy control of their physical and chemical properties by the suitable selection of precursors and the optimization of processing parameters. In this study, we synthesized photo-patternable methacrylate hybrid materials (hybrimers) using simple sol-gel reaction for the gate dielectrics in OTFTs. The hybrimer thin films had smooth and hydrophobic surfaces, and were stable with solvents. The hybrimer thin films had good electrical properties such as low leakage current density and high dielectric strength. Pentacene-based OTFTs were fabricated using the top contact geometry. Field effect mobility and threshold voltage of pentacene-based OTFT with hybrimer gate dielectric are ~0.66cm^2/Vs and -14V, respectively. The hysteresis of OTFT with hybrimer gate dielectric is small.

Keywords: organic thin film transistor, solution processible gate dielectric, organic-inorganic hybrid, photo-patternable