Effect of ELA on a-IGZO TFT

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Effect of Excimer Laser Annealing on the Performance of Amorphous Indium GalliumZinc Oxide Thin-Film Transistors

This article reports a method for reducing the contact resistance between amorphous-InGaZnO (a-IGZO) channel and source/drain layer via XeCl excimer laser annealing (ELA) and the device performance of a-IGZO thin-film transistors (TFTs) in terms of laser energy density. The source/drain region in the a-IGZO layer was selectively ELA-treated using a mask, and the resistivity dramatically reduced compared to that of the untreated film (from 10^4 to 10^{-3} Ω cm). Our TFTs had a field-effect mobility of 21.7 cm^2/Vs, an on/off ratio of 1.2 x 10^8, a threshold voltage of −0.15 V, and a subthreshold swing of 0.26 V/decade.

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Table I. Comparison of the various device characteristics of a-IGZO TFTs as a function of XeCl eximer laser density.

Laser energy density (mJ/cm^2)	μ_{FE} (cm^2/V s)	S (V/decade)	V_T (V)	$I_{on/off}$ (ratio)	$R_{SD}W$ (Ω cm)
0	11.07 ± 0.62	0.88 ± 0.01	5.05 ± 0.60	7.0×10^7	109.8
90	16.06 ± 0.32	0.47 ± 0.08	3.39 ± 0.96	8.4×10^7	78.2
130	21.79 ± 0.69	0.26 ± 0.05	−0.15 ± 0.16	1.2×10^8	41.7

Table I shows that μ_{FE} significantly increased with increasing laser energy density to 130 mJ/cm^2. The S value and $I_{on/off}$ ratio were improved to 0.26 V/decade and 1.2 x 10^8, respectively, for the devices that were laser-irradiated at 130 mJ/cm^2, and VT was shifted to nearly zero 0.15 V, which is desirable for low power consumption AMLCDs and AMOLEDs.

Keywords

Amorphous semiconductor;Contact resistance;Electrical resistivity;Excimer lasers