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Effect of polysilsesquioxane passivation layer on the dark and illuminated negative bias stress of amorphous InGaZnO thin-film transistors

Nara Institute of Science and Technology [1], AZ Electronic Materials Manufacturing Japan K.K. [2],

○(D)Juan Paolo Bermundo[1], Yasuaki Ishikawa[1], (M2)Haruka Yamazaki[1], Toshiaki Nonaka[2],

Yukiharu Uraoka[1]

E-mail: b-soria@ms.naist.jp

Amorphous In-Ga-Zn-O (*a*-IGZO) has become a popular active channel material for thin-film transistors (TFT) because of properties such as low fabrication temperature, high mobility (μ), low threshold voltage (V_{th}) and small subthreshold swing (S) [1,2]. However, reliability is a problem especially for unpassivated bottom gate type TFT. Addition of passivation layer is needed to protect the exposed channel from environmental effects, desorption of oxygen and water, and post fabrication processes which degrade the reliability [3]. In this work, we report the effect of using a polysilsesquioxane-based passivation layer on *a*-IGZO TFT. Sample 1 had polymethylsilsesquioxane as the passivation material while a copolymer of methylsilsesquioxane and phenylsilsesquioxane, with a methyl/phenyl ratio of 3:2, was used for Sample 2. Basic structure of both passivation materials are shown in Figure 1. A simple solution process was employed to coat the passivation layers. The passivation material was initially spin-coated on the *a*-IGZO TFT at 3000 rpm for 15 s. Prebaking was then performed 130 ^{o}C for 90 s, followed by annealing in air at 300 ^{o}C for 1 hour. The negative bias stress stability of both passivated samples and an unpassivated TFT was tested after 3 weeks. Results of the dark negative bias stress are shown in Figures 2 and 3. Anomalous hump effect is observed for the unpassivated TFT especially at high V_g, while it is suppressed for sample 2. Furthermore, a large V_{th} shift of -2 V is observed for sample 1, -1.23 V for the unpassivated TFT, while sample 2 had the least V_{th} shift of -0.5 V. In terms of ΔS, sample 1 showed the worst S degradation as stress time increased.

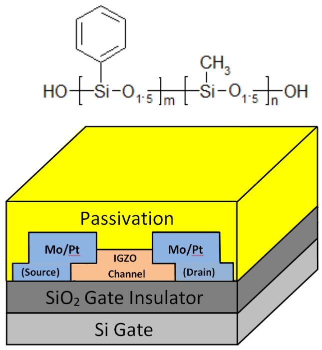

Figure 1. Polysilsesquioxane structure and *a*-IGZO Bottom Gate TFT with passivation layer

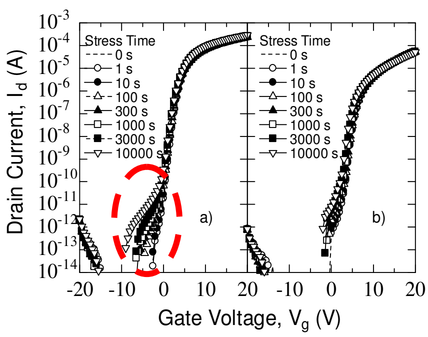

Figure 2. TFT characteristics of a) unpassivated TFT and b) Sample 2 under Negative Bias Stress (dark, V_g = 20 V)

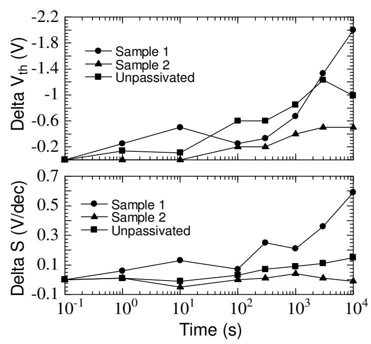

Figure 3. V_{th} and S shift after Negative Bias Stress (dark, V_g=20 V)

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