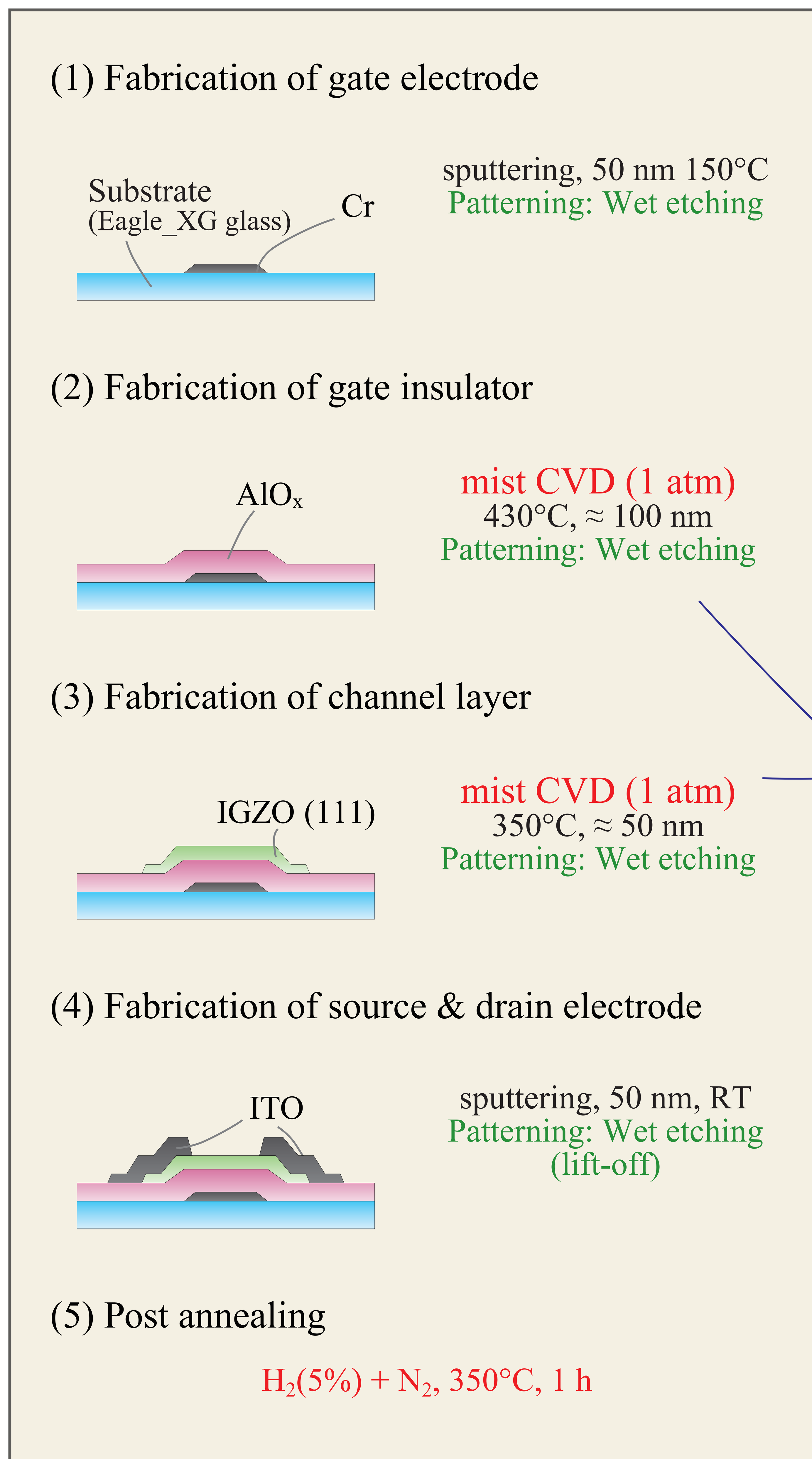
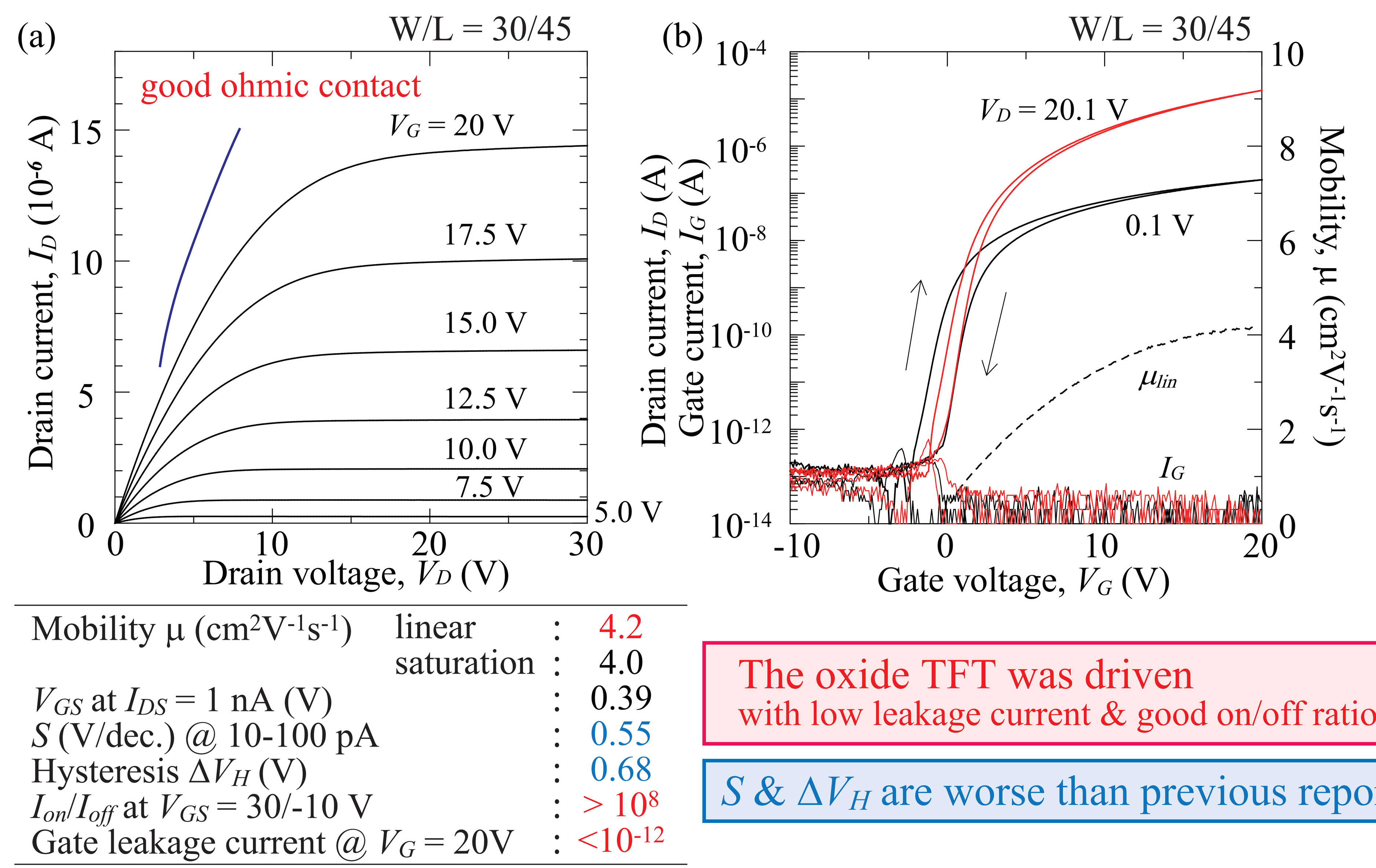
– Fabrication process –



– The drive of the first prototype –



Mobility μ ($cm^2V^{-1}s^{-1}$) linear	:	4.2
saturation	:	4.0
V_{GS} at I_{DS} = 1 nA (V)	:	0.39
S (V/dec.) @ 10-100 pA	:	0.55
Hysteresis ΔV_H (V)	:	0.68
I_{on}/I_{off} at V_{GS} = 30/-10 V	:	> 10^8
Gate leakage current @ V_G = 20V	:	<10^{-12}

The oxide TFT was driven with low leakage current & good on/off ratio.

S & ΔV_H are worse than previous reports

(a) Output and (b) transfer characteristics of oxide TFT with a IGZO/AlOx stack fabricated by mist CVD.

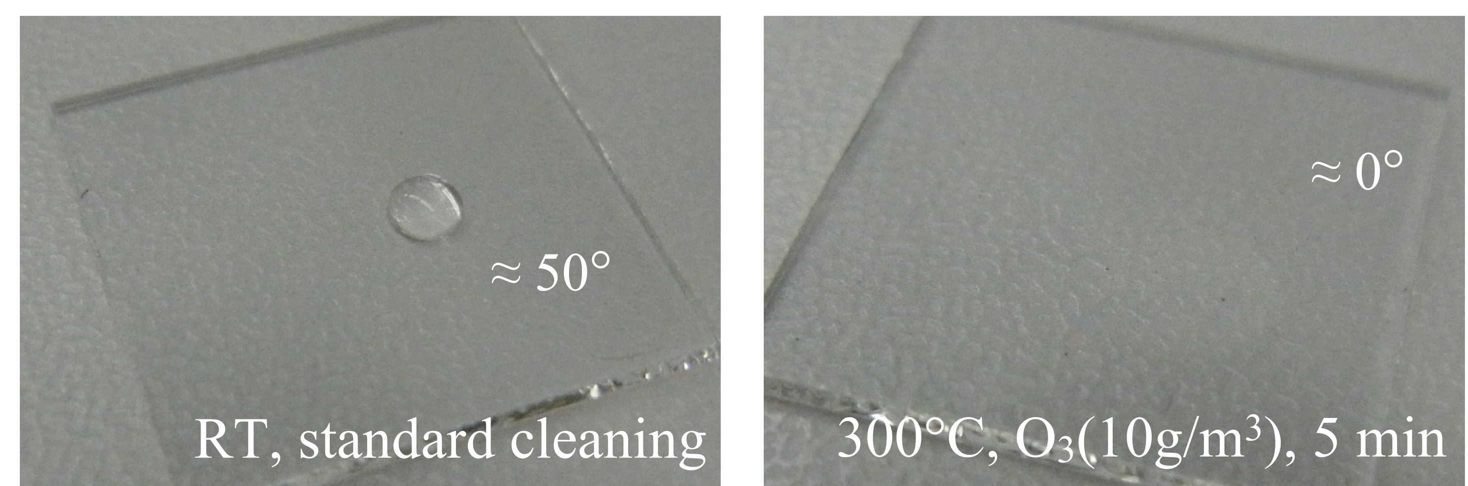
In this experiment, for the system construction of mist CVD, TFT was left under atmosphere for several hours after growing AlO_x insulator before growing IGZO channel layer. Therefore, the creation of defects or traps in the IGZO channel layer or in interface between the AlO_x insulator and the IGZO channel layer is not denied.

Moreover, in this research, the oxide TFT has no passivation film.

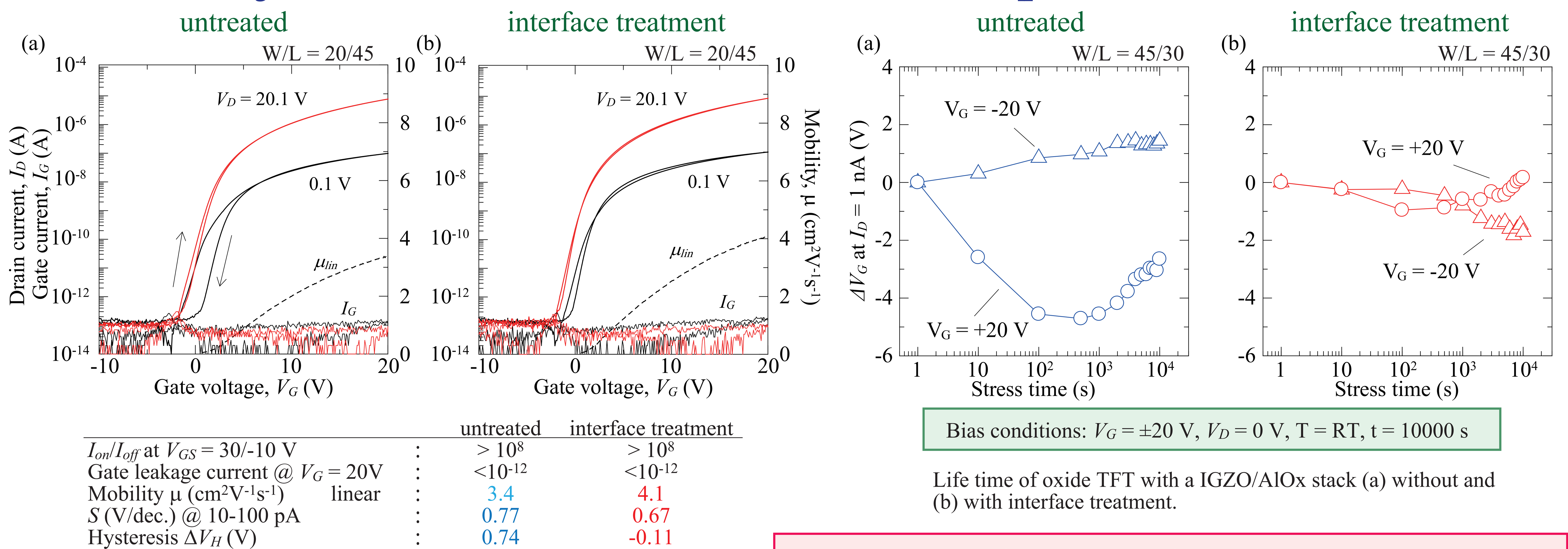
S & ΔV_H may be improved with continuous process and interface treatment.

– Effect of O_3 treatment on the AlO_x –

Treatment process of the AlO_x thin film surface was added for 5 min at 300°C under O_3 ambient, after growth of AlO_x and just before growth of IGZO. After the O_3 treatment, the surface of AlO_x thin films was cleaned with eliminating of impurities, such as an organic matter adhering to the surface and was changed to the hydrophillic.



– Effect of O_3 treatment on the interface between AlO_x & IGZO –



		untreated	interface treatment
I_{on}/I_{off} at V_{GS} = 30/-10 V	:	> 10^8	> 10^8
Gate leakage current @ V_G = 20V	:	<10^{-12}	<10^{-12}
Mobility μ ($cm^2V^{-1}s^{-1}$) linear	:	3.4	4.1
S (V/dec.) @ 10-100 pA	:	0.77	0.67
Hysteresis ΔV_H (V)	:	0.74	-0.11

Transfer characteristics of oxide TFT with a IGZO/AlOx stack (a) without and (b) with interface treatment.

Bias conditions: V_G = ±20 V, V_D = 0 V, T = RT, t = 10000 s

Life time of oxide TFT with a IGZO/AlOx stack (a) without and (b) with interface treatment.

The improvement of μ and ΔH was found with the O_3 treatment.
The effect of the O_3 treatment is clearly seen in the life time evaluation.

S is still worse than previous reports.

Conclusion

1) Oxide TFT consisting of both channel layer (IGZO) and gate insulator (AlO_x) grown by mist CVD which is one of suitable techniques for growing thin films continuously under atmosphere was fabricated.
2) The improvement of μ and ΔH was seen with introduction of the interface treatment under O_3 ambient.
3) The index of non-vacuum process conversion of the TFT fabrication process was demonstrated with fabricating the oxide TFT with an IGZO/AlO_x stack grown by the mist CVD.

Please refer
"Electrical Properties of the Thin-Film Transistor With an Indium–Gallium–Zinc Oxide Channel and an Aluminium Oxide Gate Dielectric Stack Formed by Solution-Based Atmospheric Pressure Deposition"
M. Furuta, T. Kawaharamura, D. Wang, T. Toda, and T. Hirao,
IEEE Electron Device Lett. Vol.33 (2012) pp.851-853.

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