高背圧下 PLD により作製した高移動度 In_2O_3 薄膜を活性層とする TFT

Thin Film Transistors with High-Mobility In_2O_3 Thin Films that Fabricated under High-Base Pressure as Active Layers

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Very recently, we found that polycrystalline In_2O_3 films fabricated by pulsed laser deposition (PLD) under relatively high base pressures (1.0×10^{-3} Pa) showed extremely high Hall mobility (112.5 $cm^2\ V^{-1}\ s^{-1}$) after annealing at 200 °C in vacuum.[1] Like previous report by Magari *et al.*[2], hydrogen incorporation might occur and suppress the crystallization at room temperature, and abnormal grain growth occurred when the films were annealed at 200 °C. In this study, we fabricated thin film transistors (TFTs) using the high-mobility In_2O_3 films as the active channel. First, a 100-nm-thick AlO_x gate insulator (70.8 nF cm^{-2}) was deposited on ITO-coated alkali-free glass substrate (Corning® EAGLE XG®) by atomic layer deposition. Then In_2O_3 channel layer with different thickness (5−50 nm) was deposited by PLD through a stencil mask at room temperature. The base pressure was kept at 1.0×10^{-3} Pa while oxygen pressure was kept at 3 Pa during the deposition. After that, 100-nm-thick ITO films that served as source and drain electrodes were deposited by PLD through a stencil mask. Finally, the films were annealed at 250−350 °C for 30 min in air. **Figure** shows typical transfer characteristic curve of the resultant TFT with 5-nm-thick In_2O_3 channel layer. The field effect mobility (μ_{FE}) was ~80 $cm^2\ V^{-1}\ s^{-1}$. Although the μ_{FE} is lower than that demonstrated by Magari *et al.* (μ_{FE} = 139 $cm^2\ V^{-1}\ s^{-1}$), we believe that the μ_{FE} would be improved by further optimization of base pressure of PLD chamber. In the presentation, we will show the results of electric field thermopower modulation analyses of the effective thickness as well.

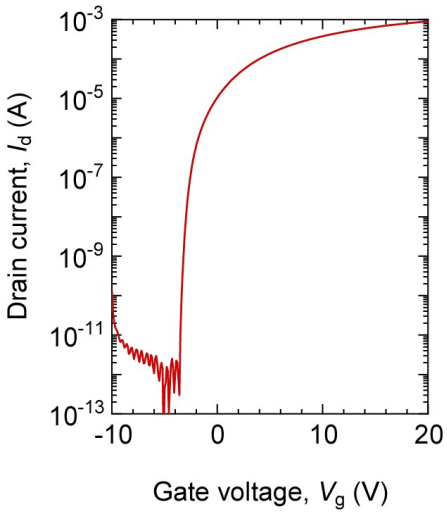

Figure | Typical transfer characteristic curve of the In_2O_3-TFT (L = 200 μm, W = 400 μm). Applied drain voltage is 5 V. The field effect mobility (μ_{FE}) is ~80 $cm^2\ V^{-1}\ s^{-1}$.

References

[1] 曲ら，第 70 回 応用物理学会 春季学術講演会，上智大学 2023.3.15−18
[2] Y. Magari *et al.*, *Nat. Commun.* **13**, 1078 (2022).