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Mobility Improvement of La-silicate MOSFET by W_2C Gate Electrode
W_2C ゲート電極による La-silicate MOSFET の移動度改善

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【Introduction】 La-silicate gate dielectrics are regarded as promising candidates for gate dielectric materials for further equivalent oxide thickness (EOT) scaling, owing to fairly nice interface properties [1]. However, mobility degradations were observed with thinning the thickness, the reason is believed to be the influence of gate electrode material [2]. In this work, we have adopted tungsten carbide as gate electrode to investigate effective electron mobility of La-silicate MOSFET.

【Experiment】 After performing SPM and HF chemical cleanings, thin La_2O_3 gate dielectric films were deposited by e-beam evaporation at a substrate temperature of 300 °C. Tungsten and carbon multi-stacking layers with total thickness of 10 nm were deposited by RF magnetron sputtering. TiN (10nm) and Si (100nm) capping layers were deposited on W/C metal also by RF sputtering to inhibit oxygen atoms diffusion to high-k layer [2]. The samples were annealed at 800°C in F.G ambient. S/D and back side contacts were formed by Al deposition. Finally, the sample was annealed in forming gas (N_2:H_2=97:3) ambient at 420 °C for 30 minutes.

【Results and discussion】 Figure 1 shows electron effective mobility of La-silicate MOSFET with W_2C gate electrode, higher effective mobility of 163cm^2/V.s with small EOT=0.63nm were achieved by W_2C gate electrode owing to lower interface state density and reduced roughness scatterings. Benchmarking of μ_{eff} at high E_{eff}, as shown in Figure 2, showed improvements beyond μ_{eff}-EOT trends with W_2C gate.

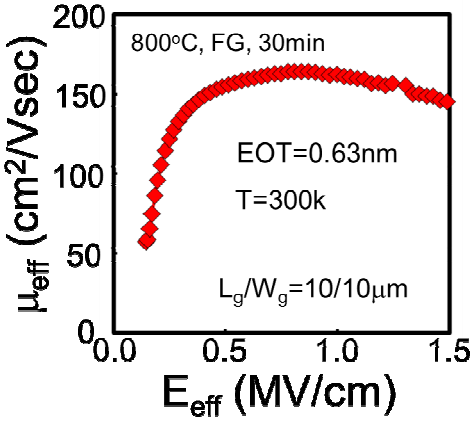

Figure 1. Electron effective mobility of La-silicate MOSFE with W_2C gate electrode

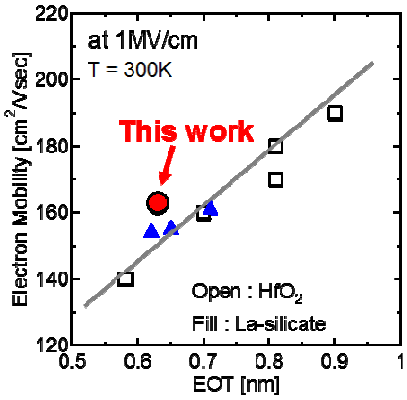

Figure 2. A benchmark of high-field electron mobility at 1MV/cm [2]

[1] K. Kakushima et al., Solid-State Electron., Vol. 54, pp. 715-719 (2010).
[2] T. Kawanago, et al., IEEE Trans. ED, Vol. 59, pp. 269-276 (2012).

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